the OIL AND GAS JOURNAL

JULY 1, 1957

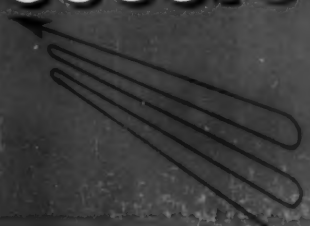
WHAT'S NEXT WITH IMPORTS

- Look for *ACTION* this Month p. 79
- New Ideas for Control Offered p. 80
- Record Flow Planned Through Fall p. 82

EDITORIAL: Last Chance to Avoid Federal Control. p. 75

how to estimate

Pressure Drop in Heaters



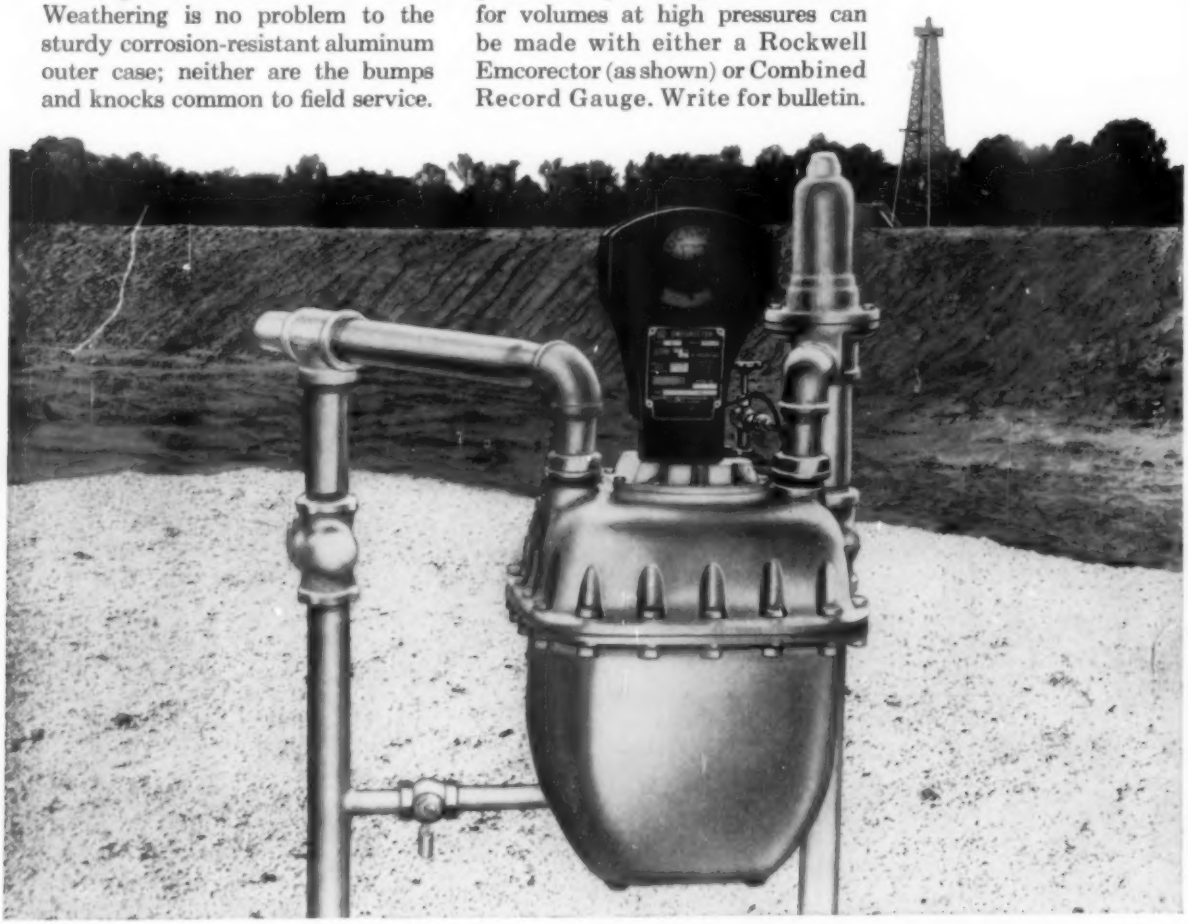
New method allows making continuous heat balance while determining pressure vs. coil length. p. 111

The LIGHT way to measure field gas

(at up to 100 lbs. working pressure)

The Rockwell "1600" is your best bet for measuring gas sold or used around the lease. Here's why. This meter weighs only 63 lb., so is easy to carry onto location and install. Weathering is no problem to the sturdy corrosion-resistant aluminum outer case; neither are the bumps and knocks common to field service.

With it you get a generous capacity rating of 1600 cfh at 4 oz inlet pressure. You can increase this rating materially by measuring gas at higher pressure—up to 100 psi. Corrections for volumes at high pressures can be made with either a Rockwell Emcorector (as shown) or Combined Record Gauge. Write for bulletin.



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JOURNAL News Letter

July 1, 1957
Tulsa, Okla.

Eisenhower is fighting time now on the thorny imports problem:

He is under terrific pressure to do something quick to stem the flow of foreign oil. That's what will happen--perhaps within 2 or 3 weeks. A top committee of the Cabinet is working out the details now. Eisenhower turned the problem over to these six men instead of a disinterested commission as originally planned in the interest of speed.

This much is known of the cabinet committee's thinking on a control plan:

...Tariffs are out.

...Quotas by countries also are disfavored.

...Quotas on importers individually have most support. Each importer then could choose his own source of foreign oil.

Still to be decided: A formula for assigning individual quotas. A method of cutting new importers into the picture. And who'll enforce the plan--the government by compulsion or the oil industry by voluntary means (P. 79).

SIGNS AHEAD: Crude imports will hit an all-time record in July unless a control plan is slapped on them, according to Texas Railroad Commission reports. Importers expect to bring in 1,216,200 bbl. daily that month. Previous high was 1,083,000 bbl. daily in July, 1956. Million-barrel-daily months will start in June and continue through October (P. 82).

Some trends in commission figures: Canadian imports will slip slightly, while those of the Middle East and Far East will pick up strength. West Coast imports are stepping up faster than those on the East Coast.

GOOD OMEN: Business men will increase outlays on new plant and equipment through the third quarter. SEC reports the modest upward trend at such high levels of investment continues to be an element of strength in the business situation.

SEC estimates capital investment programs in third quarter at $37.9 billion. They were almost $37 billion in the first quarter and $37.3 billion in the second. Third-quarter investment last year was just under $36 billion.

BIG SWITCH: Major impact of Texas Eastern's conversion of Little Big Inch

to products in September is expected on refiners, marketers, and rival transport facilities.

The Little Inch will be switched to products from Baytown on the Texas Gulf Coast as far as Moundsville, W. Va., a distance of 1,168 miles. The company will lay a 231-mile, 14-in. extension from Seymour, Ind., into Chicago.

The result: Gulf Coast refined products will be made available in greater volumes in both Midwestern and Eastern markets. It will change marketing patterns over a wide area. It also will affect business of barge operators, truckers, and some railroads. Some refiners fear the conversion will permit Gulf Coast and Mid-Continent refiners to dump surplus products on the Midwestern market and depress prices. But many refiners who logically would use the line also refine and market in the Midwest and can be counted to serve as a stabilizing influence (P. 88).

QUICK TURN: The FPC's reversal of its earlier price ruling on gas the C.A.T.C. Group wanted to sell to Tennessee Gas Transmission may well be the turning point in economics of offshore oil-gas operations (P. 84).

The situation was this: C.A.T.C. had contracted with Tennessee Gas to sell its tremendous reserves offshore for 21.4 cents plus 1-cent gathering charge. FPC allowed only 17 cents plus gathering charge, and C.A.T.C. called the deal off. The government agency relented, however, after Tennessee Gas appealed for rehearing. Here's what the fuling now is expected to mean:

...An early boom will develop in building offshore pipelines. Tennessee Gas will start soon on its big line to the offshore fields, may extend the line to other areas. Other deals are sure to prompt more building.

...Development drilling will increase gradually as operators return to gas fields temporarily abandoned because of the price picture.

...Natural gas will shoulder more of the load in financing further drilling in the gulf.

...The FPC's new attitude toward gas prices will set a benchmark. It now has recognized two facts: Big gas reserves are worth more per cubic foot than smaller ones. Producing costs must be considered in setting the price of gas.

COURT: Louisiana at least has won a minor victory in its boundary dispute with the Government. Supreme Court has decided to make a full-scale test of the squabble. Court will decide the issue next term after all Gulf states from Florida to Texas have had a chance to intervene. Justice Department had asked for an immediate ruling that Louisiana's boundary was 3 miles beyond the low-water line.

EXPLORATION: Standard of California will try once again to find oil in Washington. It plans to start a wildcat in mid-month in Rattlesnake Hills of Benton County, southeastern Washington. About 100 miles south of this location the company also is drilling below 8,700 ft. at a wildcat near Condon, Ore. Both states currently are nonproductive.

The French oil giant, Cie. Francaise des Petroles, plans a stepped up exploration and drilling program in Canada. The big push will follow a $15.8 mil-

lion financing plan now under way for French Petroleum Co. of Canada, a C.F. P. affiliate. French Petroleum currently is drilling joint ventures in British Columbia with Richfield. Future plans call for stepped-up operations into Alberta and Saskatchewan. Already after only 4 years in Canada, company has net acreage interest of 1,650,000 acres, proved oil reserves of 7,345,000 bbl., plus probable reserves of 3,040,000 bbl., and annual production of 123,000 bbl.

Some interesting wildcat frontiers will bear watching in the Rocky Mountains during the second half of the year. Here are the top ones: Mesaverde-Cretaceous and Pennsylvanian discoveries in Powder River basin point to increased wildcatting in that Wyoming area... Williston basin also will get active play because of continued success in Outlook area of northeastern Montana plus new Mississippian discoveries on Nesson anticline and northeast side of basin ...Paradox basin campaign will continue strong. Utah portion has 44 active rigs now.

DRILLING: Faster and cheaper drilling is the goal of every operator and contractor these days. A seven-point drilling program developed by one contractor has saved 18 days and used 50 per cent fewer bits on four wells. It depends on cooperative efforts by both operator and contractor (P. 129).

For better drilling, cementing, and fracturing, engineers are now trying to determine the tensile and compressive strength of formations. The information holds the key to many problems. A Louisiana State professor has compiled these data for a number of West Texas formations and reveals them on p. 138.

PRODUCTION: First slow moves finally are taking shape to unitize huge Wilmington field near Long Beach, Calif. The goal is increased crude recovery and checking subsidence. Latest developments: Richfield Oil is urging immediate negotiations for unitizing and repressuring one section of the field... City of Long Beach and Union Pacific Railroad have started joint engineering study before stepping up a water-injection program in field's Tar Zone.

New information on bottom-hole heating is now available from experiences of operators in California with the new production tool. It has been tested for several years there. Here's the economics on the heaters: Average cost is about $2 daily. Benefits not only include greater production volume but other economies in producing the wells (P. 119).

PIPELINING: The first 40-in. pipeline ever laid is planned by Creole in big gas-repressuring system in Venezuela's Lake Maracaibo. Largest-diameter pipe in service now is 36-in. Brown & Root, the contractor for Creole, may have to build special equipment to handle the heavy pipe.

Slow-scan television may have a future in monitoring remote-controlled pipeline stations and plant facilities. TV has been too expensive in past because it requires an entire microwave system. But the slow-scan picture changes only once every 3 seconds and requires only two or three channels, leaving others for operational uses.

One steel company has had good results in experiments with high-yield-strength pipe. A tempered martensite steel has been used in 6-5/8 and 8-5/8-in pipe. End product has a yield strength of 110,000 psi. This compares with

present line pipe with maximum of 52,000-psi rating. High-yield strength pipe means thinner wall thickness with less cumbersome joints and requires lighter laying equipment. One disadvantage: Costs may run from 2-1/2 to 3 times that of today's regular line pipe.

Aramco engineers have a mobile detector that has taken much of the footwork out of corrosion checks on the company's Middle East pipeline. They have mounted a standard detector on a trailer towed by truck. The instrument spots leaks or potential leaks by detecting the points where protective coatings have parted or worn thin.

French have placed orders for 16-in. pipe for a 450-mile Algerian-Libyan crude line. The artery will carry oil from Edjele field in southeast Algeria to a Libyan port on the Mediterranean near Tripoli.

Why do pipelines seldom break at river crossings any more? A few years ago such breaks were common. But a lot of engineering work on the problem has been done since then. An engineering expert points out what we've learned about pipeline river crossing in an interesting three-part article beginning on p. 107.

REFINING: U. S. motor-fuel octanes this summer in general are comfortably ahead of car requirements. It's the result of ultra high-octane third grades and competitive moves by refiners to boost premium in their two-grade systems. Detroit is taking note, too. Expect 1958 autos, as a result, to come out with compression ratios averaging one-half unit higher than the 1957 models.

That new butadiene plant in Canada may be built at Sarnia instead of Red Deer, Alta. Polymer Corp., the government-owned synthetic-rubber firm, is leaning toward Sarnia because it could use butane-butylene stocks from Imperial's nearby petrochemical plant. Polymer already has a site purchased at Red Deer, where butane is plentiful. But transporting finished butadiene from there to Sarnia would be expensive.

Hot controversy still surrounds the refinery which Commerce Oil Refining Corp. proposes to build in the Narragansett Bay area of Rhode Island. Commerce has purchased the site. Local permits and rezoning have been cleared. Commerce even has begun some earth moving. But some local residents still fight the project. Army Engineers also are reserving a decision on a pier project to handle supertankers bringing in crude.

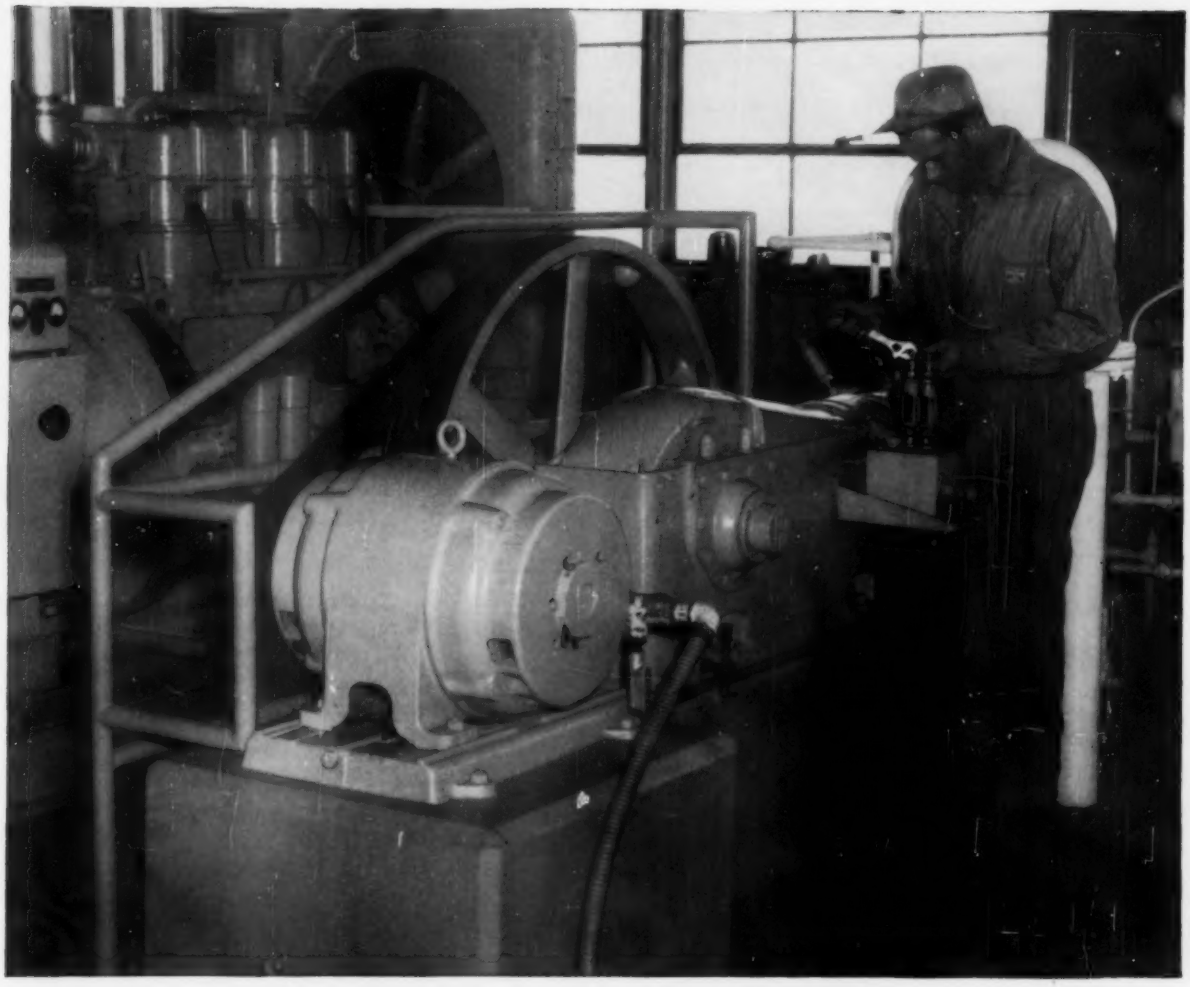
Refinery construction costs have risen slightly again. Latest Nelson refinery construction index stands at 201.8 compared with 201.7 last month. The factors behind the change were rises in costs of internal-combusion engines and materials. These were partially offset by declines in costs of electrical machinery and labor component (P. 123).

A new synthetic resin produced through polymerization of propylene is claimed by the Montecatini chemical group of Italy. It reportedly can withstand temperatures up to 300°F. and in thickness of six hundredths of a millimeter can carry 200 lbs. weight.

Other refiners are following Sinclair's lead in increasing wholesale prices of products to offset recent wage increases. Latest to adjust prices are Esso Standard, American Oil, Standard of Ohio, Shell, and Gulf.

Phillips has begun full-scale operations at its 200-ton Coulee ammonia plant in Washington. The plant operates on natural gas brought from San Juan basin by Pacific Northwest pipeline.

B.F.Goodrich report:



Belts used to slip on this stop-and-go drive

B. F. Goodrich improvements in rubber brought extra savings

Problem: A breakdown of that V belt drive could cut off the natural gas supply to a large Midwest area. The drive is on an air compressor used to start huge engines that pump gas through a pipeline. Ordinary V belts couldn't take the stress of frequent starts and stops in around-the-clock service. They stretched, slipped, didn't deliver full power.

What was done: The problem was solved when they put on B.F.Goodrich Grommet V belts. Grommet belts stretch less—only ⅓ as much, on the average, as ordinary V belts. They are more flexible, can "give" temporarily and absorb the jolt of frequent motor starts.

Savings: B.F.Goodrich Grommet V belts cut costs because they last longer, keep running with fewer interruptions and reduce maintenance costs; yet they cost no more than ordinary belts. Here is what the manager of the pumping station has to say about the performance of these Grommet belts, "After two years of dependable service with B.F.Goodrich V belts, we sure will never take a chance on any other belt."

Where to buy: You'll find B.F.Goodrich V belts at leading supply stores in the oil field, or at any one of these B.F.Goodrich warehouses: Los Angeles, Great Bend, New Orleans, Shreveport, Hobbs, Oklahoma City, Tulsa, Corpus Christi, Dallas, Houston, Kilgore, Odessa, Wichita Falls. *B.F.Goodrich Industrial Products Co., Dept. M-107, Akron 18, Ohio.*

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B.F.Goodrich

INDUSTRIAL PRODUCTS

The OIL AND GAS JOURNAL

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EXPLORATION • DRILLING • PRODUCTION • FIELD PROCESSING

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TECHNOLOGY—OPERATION

Pipelining

What We Know About Pipeline River Crossings 107
By L. M. Odom

Breaks in pipeline river crossings were quite common up until a few years ago. Larger investments made it mandatory that these be virtually eliminated. Great care is now being given to the design and construction of crossings.

Pipeline Patrol: Quadriphase Doubles Microwave Network Capacity 161
By Larry Resen

Microwave facilities on Transco's network have been expanded to 25 channels between Houston and Linden, N. J. This doubling of channel capacity was achieved through modification of existing equipment and installing multiplexing equipment.

Refining-Processing

How to Estimate Pressure Drop in Heaters 111
By Paul Buthod

In this new calculation technique, a family of enthalpy lines is superimposed on the phase diagram of the stock being vaporized. Then a continuous heat balance can be run while making a graphical integration to evaluate the pressure vs. length curve.

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Drilling-Production

Bottom-Hole Heating in California Fields 119
By D. H. Stormont

Part 2 of two parts. Numerous wells more than double the production rate before heating. In some wells there has been no production decline for several years after heating started. Average cost of heating per well is about $2 per day.

Seven Steps to Faster Drilling 129
By R. W. True and Gene Bowman

This analysis of four wells drilled in North Louisiana shows how time was reduced 18 days and bits per well cut in half with proper application of the drilling machinery and experience gained on previous wells.

Field Processing—36: Compressibility and Gas Flow 134
By Dr. John M. Campbell

As pressures have risen on natural-gas systems, the assumption of ideal gases has become less valid. It has therefore become advisable to incorporate the compressibility factor, Z, into the flow equation.

Tensile and Compressive Strengths of Formations 138
By B. C. Craft

Tensile and compressive strengths of rock formations have significant applications to petroleum engineering during drilling, cementing, and fracturing. Here's how some West Texas formations tested.

On The Job . . . In The Fields 147
By F. L. Rhoades, Jr.

To produce wells safely and economically, you must measure the extent of corrosion damage to determine the useful life of the tubing and the inhibitor effectiveness. Here are some tips on how to determine the extent of corrosion in a given well.

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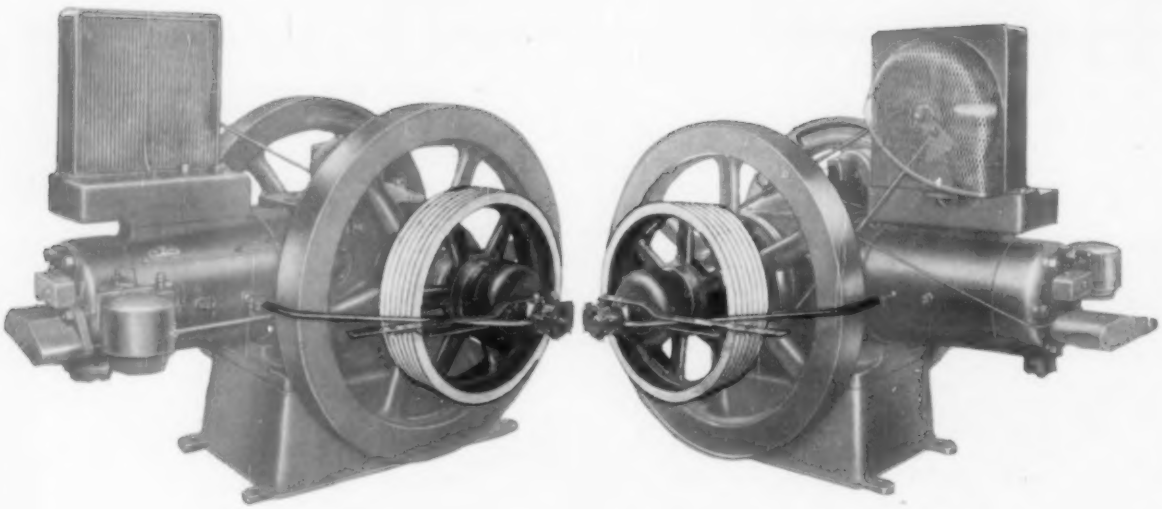

on the "ZC"

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The Fairbanks-Morse ZC engine has TWO flywheels. However you mount the clutch and sheave, there will be the smoothing effect of a flywheel between the engine and the fluctuating power demand of the pump jack. This makes for better balance and more economical operation.

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Thank you, Mr. Westby... *for reporting to us the amazing drilling record your crew established with one of our Failing Holemaster Rigs:*

Over 70,000 feet of hole in ONE MONTH!

Mr. G. H. Westby, President of the Seismograph Service Corporation of Tulsa, describes their drilling experiences with Failing Rigs in Egypt:

"Our records for the month of February, 1955, on our Egyptian crew," writes Mr. Westby, "show that one of our drillers, Dewey Ramsey, drilling with a Failing CFD-1 drill, completed a total of 70,335 feet of hole. This, we feel, is an outstanding example of what can be done by one driller and one drill, and we are quite proud of this accomplishment.

"This was in connection with work in Egypt which we were carrying out for Sahara Petroleum Company in the Qattara Depression. **Drilling in this sandy area was relatively easy but patterns of 20 to 35 holes each were required, each hole being drilled to Kelly depth. Our three Failing CFD-1 drills, each being operated by one American driller with two Egyptian helpers, were completing a pattern in approximately nine minutes.**

"We feel we are justified in being proud of this month's drilling operation; however, we are also pleased with our over-all drilling accomplishments in Egypt. We began operations in mid-July, 1954, with three Failing CFD-1 drills, and we continued with these drills through October 28, 1956, when the Suez situation forced our evacuation. **During this period, most of our drilling was in hard limestone, under conditions similar to those encountered on the Edwards Plateau, yet the drills averaged approximately 43,000 feet per month for the entire period.**

"During 1956 our drill power was augmented by the addition of two new Failing CFD-1 drills under the direction of drillers J. M. Russell and R. M. Underwood, and these, too, were doing a remarkably good job. **Your good drills and our good drillers made a working combination of which we can all be proud."**

Seismograph Service Corporation
TULSA 1, OKLAHOMA, U.S.A.

Mr. W. J. Godschalk, Advertising Manager
George E. Failing Company
Enid, Oklahoma

Dear Mr. Godschalk:

After receiving your letter of November 16th, we had intended to have the information you desired with regard to our drilling in Egypt come direct from that division, but because of the excitement caused by the evacuation of the crew from Egypt shortly thereafter, the matter was inadvertently overlooked.

Our records for the month of February, 1955, on our Egyptian crew show that one of our drillers, Dewey Ramsey, drilling with a 1954 Failing CFD-1 drill, completed a total of 70,335 feet of hole. This, we feel, is an outstanding example of what can be done by one driller and one drill, and we are quite proud of this accomplishment.

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These original three drills were operated by D. M. Ramsey, L. D. Hammer, and I. G. Lair. All three drills were going strong at the time of evacuation. Aside from the normal amount of repairs made during the period, the only change made on these drills was the addition in mid-1956 of your fluid-motor pull-down conversion kits.

During 1956 our drill power was augmented by the addition of two new Failing CFD-1 drills under the direction of drillers J. M. Russell and R. M. Underwood, and these, too, were doing a remarkably good job.

Your good drills and our good drillers made a working combination of which we can all be proud.

Very truly yours,

SEISMOGRAPH SERVICE CORPORATION

G. H. Westby, President

GHW:ed

Actual photo of Failing rigs doing pattern shot hole drilling in Egypt.

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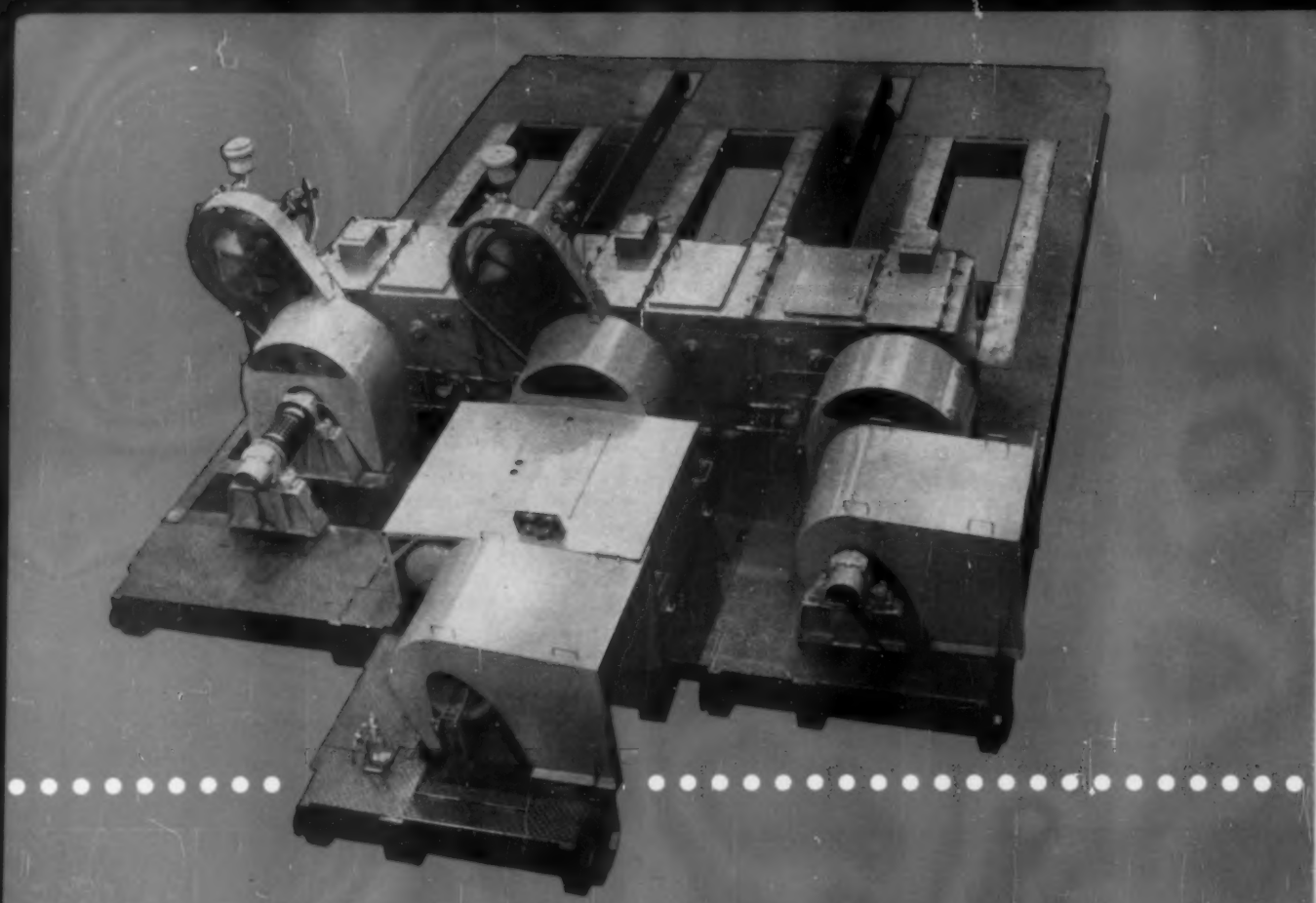

Rig up fast and cut maintenance costs with "Oilwell's" new SECTIONALIZED 1600 drive

THIS NEW DRIVE consists of three primary sections which can be designated as front, intermediate and rear. By mounting each shaft-and-case assembly on the same skid base with its associated engine, alignment is permanently maintained. This arrangement holds the number of loads to a minimum.

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HOW SELF-ALIGNMENT WORKS. Spherical inner ring, free to align in any direction, assures full load capacity regardless of shaft deflection or support misalignment.

Husky bearings in husky housings adjust immediately in any direction

When high-impact loads deal out punishment, shaft deflection may spell a quick finish for ordinary bearings. But this rugged Link-Belt bearing is *self*-aligning . . . won't "pinch" or bind when misaligned.

Complete protection is provided by effective seals which block entrance of dirt, escape of lubricant. Durable housing—machined as two perfectly matched parts provides easy installation without shims or alignment rings.

Get full data on Link-Belt's complete bearing line from Book 2550. Ask any of 40 Link-Belt offices or one of our authorized stock-carrying distributors.

Series 6800, 6900, 7800, 7900 roller bearings have internationally standardized boundary dimensions.

LINK BELT

self-aligning ball and roller bearings

14,441-B

LINK-BELT COMPANY: Indianapolis 6, Houston 1, Dallas 21, Odessa, Texas, Shreveport, La., Los Angeles 33, Scarboro (Toronto 13); Export Office, New York 7. Distributors in All Fields.

FASTEST . . . ABLEST HELICOPTERS—Two Sikorsky S-58s on their delivery flight to Humble Oil and Refining Co. are shown equipped with flotation gear. Main wheels are retractable. In the Gulf of Mexico area alone, versatile Sikorsky S-58s and S-55s are carrying more than 20,000 crewmen and specialists each month.

S-58—Newest, Fastest, Ablest

TWELVE PASSENGERS and baggage are routine loads for Sikorsky S-58 helicopters operated by Rotor Aids Inc. on flights offshore as pictured here. This long-established operator maintains round-the-clock commuting service with these agile helicopters to platforms on rigs or tenders. Float-equipped S-58s can carry full loads 125 miles offshore and return without refueling.

Already hard at work in the Gulf of Mexico area, new twelve-passenger Sikorsky S-58 helicopters are speeding up the progress of offshore drilling operations. The S-58 equipped with floats can fly 125 miles offshore and return without refueling. It cruises at better than 90 mph. Offering oil companies and charter operators the latest advances in the helicopter art, the S-58 is the newest and ablest offshore transport, carrying more men farther and faster than any helicopter previously available.

The new Sikorsky S-58 and its companion, the S-55, are the acknowledged leaders in offshore transport helicopter service. Sikorsky helicopters every day are solving more and more transportation problems in offshore oil activities, as they have in so many other activities all over the world where surface transport is difficult.

For more information on Sikorsky helicopters, telephone or write Lee S. Johnson, general manager, Sikorsky Aircraft.

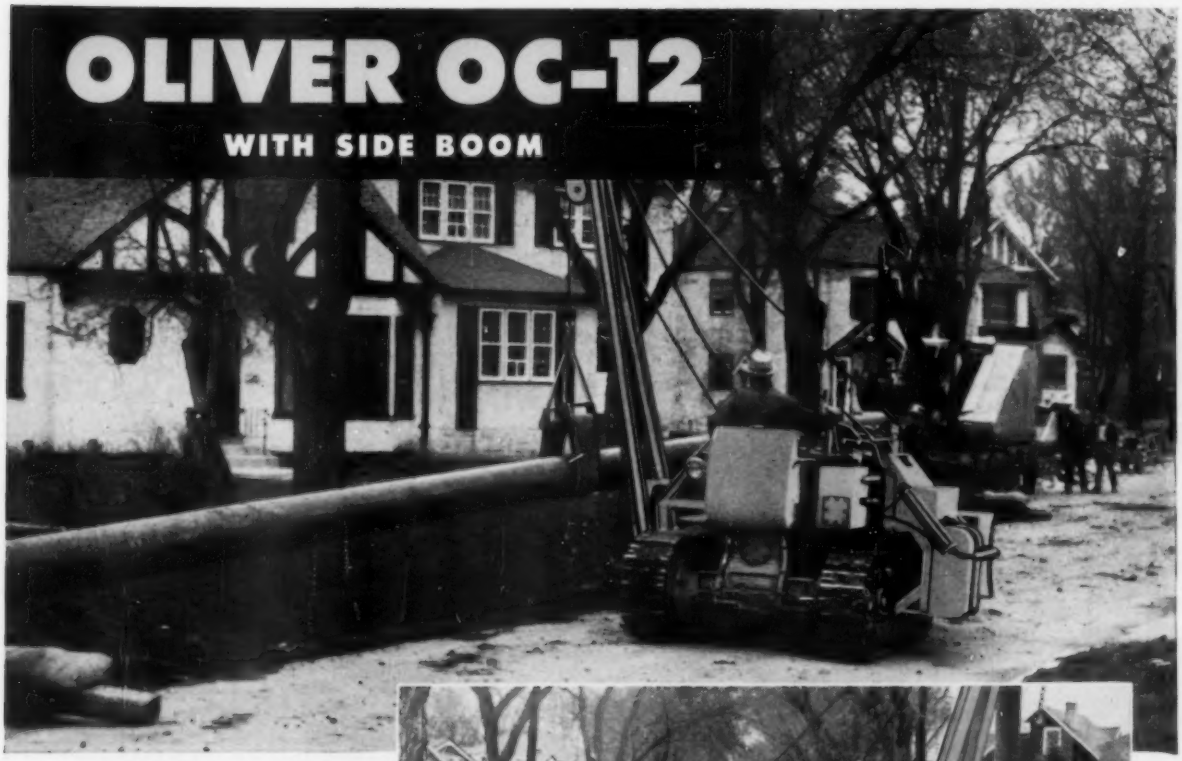
SIKORSKY AIRCRAFT

BRIDGEPORT, CONNECTICUT

One of the Divisions of United Aircraft Corporation

OLIVER OC-12

WITH SIDE BOOM



POWER-TURN STEERING speeds operations

"POWER-TURN gives us a big advantage on low-lying streets where a short turn is necessary—and where we still want power on both tracks. We like the low and high range of speed in the OC-12 and the flexibility of power."

"Most versatile machine on our large construction job"

On this big main line installation in Winnipeg, Manitoba, G. M. Gest Ltd., gas line contractor, regards the OC-12 with side boom as the most efficient all-around machine on the market.

The OC-12 serves four uses on this job: (1) unloading large parts, (2) carrying pipe long distances, (3) placing pipe in trenches, and (4) backfilling.

"Being able to backfill with a side boom tractor in such cramped areas speeds up our job materially," says Superintendent Russell Gates.

Easy maneuvering with Oliver's exclusive POWER-TURN gives production a big boost. POWER-TURN provides speeds ranging from 1.60 to 5½ m.p.h....a full 61 h.p....and the smoothest handling tractor you ever saw!

The Model OC-12 side boom has a lifting capacity of 13,000 lb. Only two simple controls are required for operating the hydraulic side boom and controlling cable speeds for fast, smooth handling.

Your Oliver distributor has full information about the OC-12 and other Oliver equipment used in pipeline, oil field and refinery work.

OLIVER **THE OLIVER CORPORATION**

400 West Madison Street, Chicago 6, Illinois

a complete line of industrial wheel and crawler tractors and matched allied equipment

New Servco Section Mill

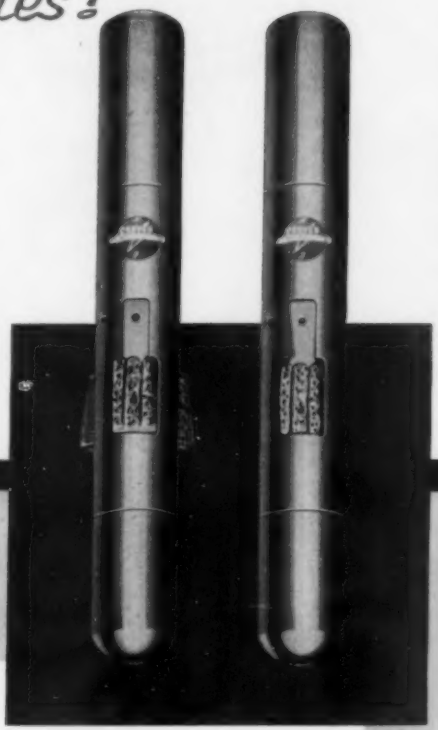
cuts 30′ of 7", 26#, N-80 casing

in 10 hours, 40 minutes!

Typical of the unusually fast milling speeds possible with the new Servcoloy* process.

Actual job records show that Servco milling tools dressed with Servcoloy* mill at speeds up to 10 times faster than conventional milling tools. This fast cutting action is largely due to a unique method of suspending hundreds of tungsten carbide particles in a tough, elastic matrix. As cutting edges of the carbide particles are worn or torn away from the matrix, new cutting edges are automatically exposed. Since hundreds of fresh cutting edges are always at work, remedial work which formerly took days to do, can now be done in hours.

*Patents pending.



CAN YOUR PRESENT MILLING METHOD MATCH THESE SERVCOLOY JOBS?

- One tool (one trip in the hole) milled 20 feet of 8⅝", 28 lb., Grade C casing in 9 hours, 35 minutes.
- One tool (one trip in the hole) milled 30 feet of 8⅝", 36 lb., Grade C casing in 8 hours, 27 minutes.
- One tool (two trips in the hole) milled 95 feet of 7", 20 lb., J-55 casing, plus two collars, in 21 hours, 15 minutes.
- One tool (5 trips in the hole), milled 184 feet of 7", 23 lb., J-55 casing, plus 4 collars, in 77 hours, 24 minutes.

Actual Job Records sent on request

Servcoloy now available on all Servco milling tools

ROTARY SHOES
JUNK MILLS
TAPER MILLS
WHIPSTOCK MILLS
LINER MILLS

Send inquires to

SERVCO

4920 Holmes Road, Zone 21 • Houston, Texas

General Offices: Long Beach, California; 904 Security Bldg., Zone 2

This 8-page brochure gives the complete story on Servcoloy* and Servco milling tools. Write for your copy today.

Field Offices: VENTURA • BAKERSFIELD • LAFAYETTE • HARVEY • EDMONTON

"These Galvomag anodes are a small investment to protect $20,000 worth of well casings"

Cathodic protection with Galvomag® magnesium anodes is a smart move for any oil well operator.

Corrosion can ruin well casings in a surprisingly short time. Frequently it causes leakage in the casing that floods the producing horizon. Sometimes it causes the casing to collapse. All too often, corrosion results in a costly repair job or abandonment of the well.

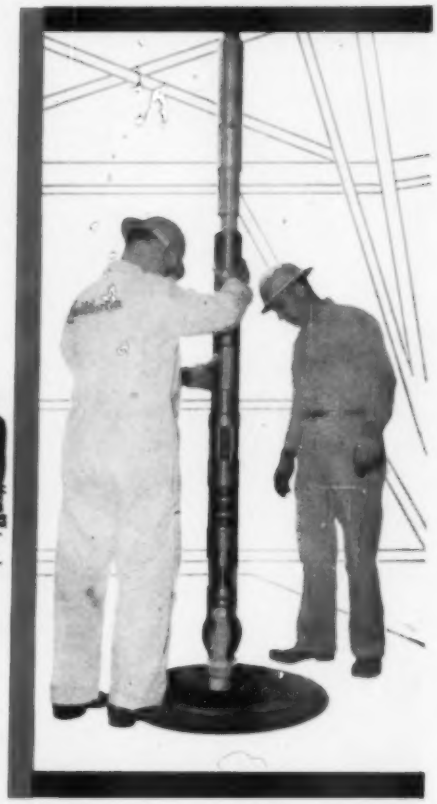
A relatively small investment in Galvomag anodes will insure any underground metal structure against corrosion. Galvomag is the name of the Dow high-potential anodes that deliver 25% more current than conventional anodes. In normal soils they give good protection with fewer units. In high-restivity soils they provide the extra current needed to assure good protection.

Contact one of the Dow magnesium anode distributors below for further information and technical assistance, or write to us. THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1427HH.

CALL THE DISTRIBUTOR NEAREST YOU: Cathodic Protection Service, Houston, Texas • Corrosion Services, Inc., Tulsa, Oklahoma • Electro Rust-Proofing Corp. (Service Division), Belleville, N. J. • Ets-Hokin & Galvan, San Francisco, Calif. • Royston Laboratories, Inc., Blawnox, Penna. • Stuart Steel Protection Corp., Plainfield, N. J. • The Vanode Co., Pasadena, Calif.

YOU CAN DEPEND ON DOW

production improvement...



RTTS Packer

one of many benefits promoted by

HALLIBURTON

SPECIAL TOOLS SERVICES

Isolating a zone to be treated for production improvement is a routine job when Halliburton Special Tools are employed.

A background of techniques that are unmatched in the industry permits advantageous use of Halliburton Special Tools for a multitude of jobs.

Whenever there is a problem in {
- Squeeze Cementing
- Formation Fracturing
- Chemical Treating under Pressure
- Lost Circulation
- Casing Leaks

you can be SURE that Halliburton Special Tools are designed to, and will, work most advantageously for you.

FOR THE MOST ADVANCED "PACK OFF" IN THE INDUSTRY... CALL HALLIBURTON FIRST

HALLIBURTON

OIL WELL CEMENTING COMPANY

DUNCAN, OKLAHOMA

AMONG HALLIBURTON'S INDUSTRY-LEADING TOOLS FOR SPECIAL PURPOSES ARE...

HALLIBURTON HRC
(HYDRAULIC RETRIEVABLE CEMENTER)

This tool is designed to perform efficiently under the highest pressures and most difficult operating conditions encountered in squeezing cement, or pumping acid or other material requiring pressure isolation.

It is retrievable and is operated hydraulically. Setting of the slips and the packer rubbers is by hydraulic pressure and is independent of pulling capacity of rig or amount of tubing weight available.

1. Packer unseats by merely picking up with pressure equalized. Does not have to be pulled loose.
2. The tubing is automatically pressure tested each time the packer is set... to 10,000 psi if desired.
3. Packer holds pressure from above or below without putting a strain on tubing.
4. Packer can be set, released, and reset as many times as desired while coming out of the hole.

TYPE "C" PRODUCTION PACKER
WITH LATCH-ON SEALING UNIT

The Type "C" Production Packer is a full-opening permanent type drillable casing packer run in on tubing and set in the casing above the oil or gas formation to serve as a long lived production casing packer for single or dual zone well completions.

Large bore diameter of packer accommodates standard tubing couplings. The Latch-On Sealing Unit reduces necessity for setting weight on packer and in many cases permits tubing to be placed in tension. Positive sealing back pressure valve closes in formation when sealing unit is withdrawn from packer.

Hydraulic Retrievable Cementer

Type "C" Production Packer

"DM-DC" Squeeze Packer

"HM" Retrievable Packer

HALLIBURTON "DM-DC" SQUEEZE PACKERS AND BRIDGE PLUGS
(DRILLABLE MAGNESIUM, DRILLABLE CAST IRON)

Designed for squeezing and bridging operations under all present depth and pressure conditions. Easily set on tubing or electrical wire line for positive fluid shutoff.

HALLIBURTON "HM" RETRIEVABLE PACKER (HYDRO-MECHANICAL)

Full-opening hook-wall packer for fracturing, acidizing or testing in cased hole.

The mechanical slips and packer rubbers are set by applying a right-hand torque to the tubing and setting down tubing weight. The hydraulic slips, located above the packer, engage the casing only when pressure is applied through the tubing to the region below the packer.

Circulating valve may be opened at any time by raising tubing.

Tool may be set as many times as desired without coming out of hole.

SPECIAL TOOLS SERVICES

251 SERVICE CENTERS—JUST MINUTES AWAY FROM ANY WELL

WORKED 6½ YEARS WITHOUT OVERHAUL

Since he first switched to GM Detroit Diesel Power

• Looking for a Diesel that's a workin' fool? One that'll keep going year in and year out without overhauls? Brother, you're looking for a General Motors 2-cycle Detroit Diesel.

But don't take our word for it. Ask Driller Marion Berry of Indiana's V.T. Drilling Company. He's bossing a GM Twin "4-71" Detroit Diesel driving Cardwell draw works that ran 6½ years before its first overhaul. He says, "one real advantage of GM Detroit Diesels is their fuel economy. Their smooth operation saves tools and their quick acceleration speeds round trips, too."

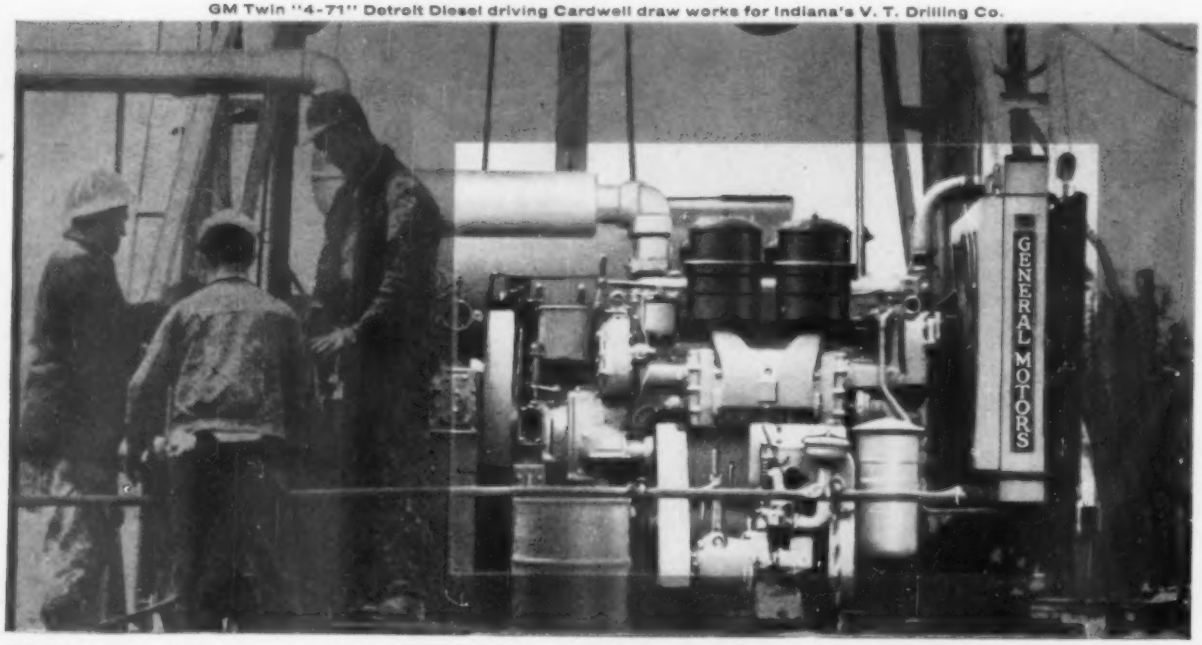
No matter where you're drilling, there's a GM Diesel Distributor or Dealer close by, ready to supply parts and service fast. And they're ready to give you all the information you want about GM Detroit Diesel power (single engines—30 to 300 h.p., multiple units—up to 893 h.p.) for your rig. Why not call the one nearest you today?

GM GENERAL MOTORS DIESEL POWER

DETROIT DIESEL

Engine Division of General Motors, Detroit 28, Michigan
REGIONAL OFFICES: New York, Atlanta, Detroit
Chicago, Dallas, San Francisco
Factory Engineered Parts—
Factory Trained Servicemen Everywhere

GM Twin "4-71" Detroit Diesel driving Cardwell draw works for Indiana's V. T. Drilling Co.



ALABAMA—Birmingham, Montgomery
ARMSTRONG EQUIPMENT CO.
Mobile
KENNEDY MARINE ENGINE CO.

ARIZONA—Phoenix
DIESEL SERVICE COMPANY

CALIFORNIA—El Monte, Long Branch, Los Angeles
ANDERSON-O'BRIEN CO.

COLORADO—Denver
THE COLORADO BUILDERS' SUPPLY CO.

FLORIDA—Jacksonville, Miami
DETROIT DIESEL ENGINE DIVISION
General Motors Corporation
(Florida Branch)

ILLINOIS—Mt. Carmel
WESTERN SERVICES, INC.

INDIANA—Evansville, Indianapolis
REID-HOLCOMB CO., INC.

IOWA—Sioux City
FEHRS TRACTOR & EQUIPMENT CO.

KANSAS—Great Bend, Wichita
DIESEL EQUIPMENT CO., INC.

KENTUCKY—Lexington, Louisville, Madisonville
BOGIE EQUIPMENT CO.

LOUISIANA—Harvey
GEORGE ENGINE CO., INC.
Shreveport
UNITED ENGINES, INC.

MICHIGAN—Detroit, Grand Rapids
PENINSULAR DIESEL, INC.

MISSISSIPPI—Biloxi
KENNEDY MARINE ENGINE CO.

MISSOURI—North Kansas City
K. C. DIESEL POWER CO.
St. Louis
WESTERN MACHINERY & ENGINE CO.

NEBRASKA—North Platte, Omaha
FEHRS TRACTOR & EQUIPMENT CO.

NEW MEXICO—Albuquerque
HARRY CORNELIUS CO.

NORTH DAKOTA—Williston
GENERAL DIESEL AND EQUIPMENT CO.

OHIO—Cleveland, Toledo, Youngstown
GREAT LAKES DIESEL CO.
Columbus
COLUMBUS EQUIPMENT CO.
Dayton, Cincinnati
FLACK EQUIPMENT CO.
Steubenville
RAY C. CALL, INC.

OKLAHOMA—Oklahoma City, Tulsa
DIESEL POWER CO.

PENNSYLVANIA—Pittsburgh
HIGHWAY EQUIPMENT CO.

TEXAS—Beaumont, Corpus Christi, Dallas, Houston, Lubbock, Odessa, San Juan
STEWART & STEVENSON SERVICES, INC.
El Paso
EQUIPMENT SUPPLY CO., INC.

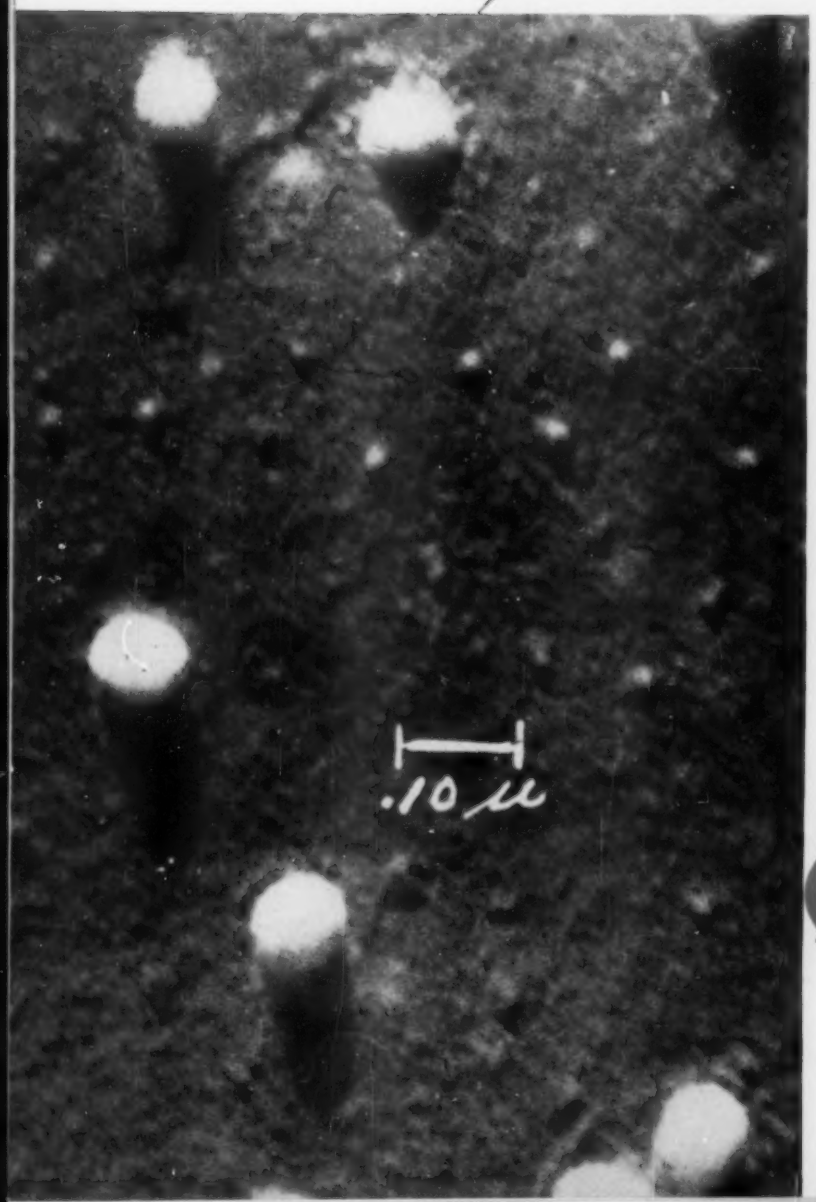
UTAH—Moab, Salt Lake City
CATE EQUIPMENT CO., INC.

WEST VIRGINIA—So. Charleston, So. Fairmont
RAY C. CALL, INC.

IN CANADA—Distributors in all key locations under
GENERAL MOTORS DIESEL LIMITED
London, Ontario

MEASURING THE UNSEEN

Influenza virus magnified 78,570 times by an electron microscope. The unit of measure shown, 0.1 μ, is 1/10,000 millimeter.



Tuboscope research in its field has been as imaginative and rewarding as the electron microscope has been in its field.

With instruments developed by Tuboscope research, Tuboscope technicians are able to measure the unseen ravages of wear, fatigue, and corrosion in oilfield tubular goods. These instruments, coupled with Tuboscope's years of experience, assure you of the best and the newest in proved methods of non-destructive inspection in the field.

The important elements of bottom hole temperature and pressure can likewise be measured by the Subsurface Engineering Division.

Tuboscope COMPANY

REG. U.S. TRADE MARK

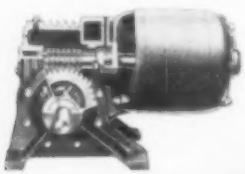
2919 HOLMES RD.

HOUSTON, TEXAS

How to dial a pair of pants

MASTER

At the touch of a switch, unit rotates and indexes correct order to delivery position. It's fast, accurate and multiplies floor space efficiency. Power is a ⅓ H.P., 115/230 volt, 60 cycle, 1 phase Master Right Angle Gearmotor.



ANOTHER DRIVE REQUIREMENT MEETS ITS MASTER

You look at a motor application in an ad, and 99 times out of a hundred first thing you say is, "But my problem's different." Here, it's 100 to one you'll be right.

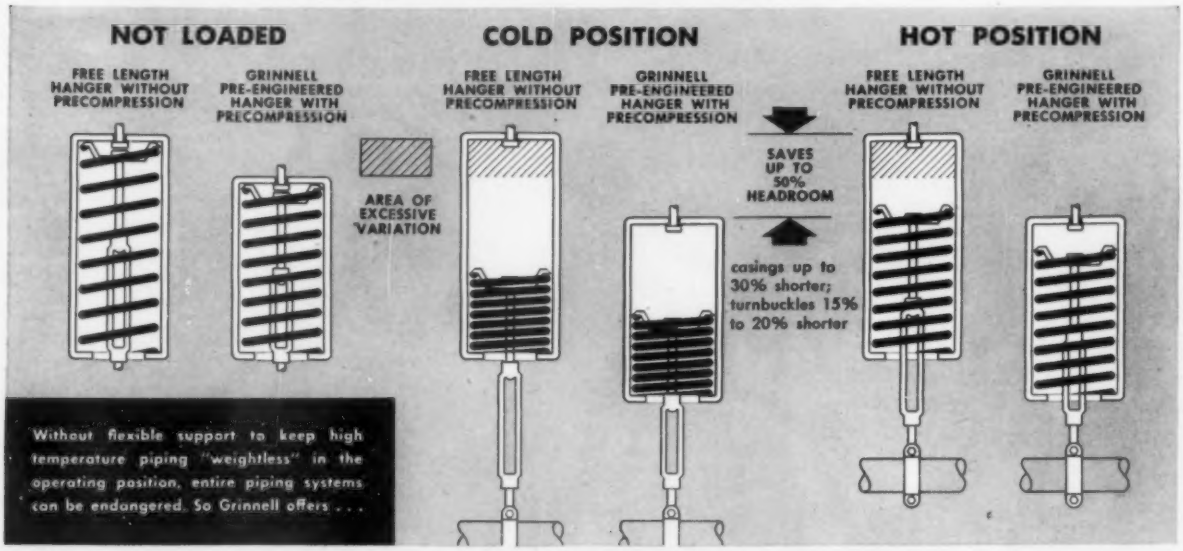
Point is the manufacturers of this fast, efficient and extremely ingenious dry cleaning storing mechanism told Master what they needed. Light, geared-down, steady power, full start, positive stop. And whenever the attendant in a progressive shop so equipped dials your pants, a Master Gearmotor delivers the goods.

And Master can deliver the goods for *you!* Master components can be integrated in any combination to give you the right horsepower, right shaft speed, right mounting features, in a single, efficient compact unit. See Master for your drives!

Motor Ratings	⅛ to 400 H.P. All phases, voltages, frequencies.
Motor Types	Squirrel cage, slip ring, synchronous, repulsion-start induction, capacitor, direct current.
Construction	Open, enclosed, splash-proof, fan-cooled, explosion-proof, special purpose.
Speeds	Single-speed, multi-speed, and variable speed.
Installation	Horizontal and vertical, with or without flanges and other features.
Power Drive Features	Electric brakes (2 types)—5 types of gear reduction up to 432 to 1 ratio. Mechanical and electronic variable speed units—fluid drives—every type of mounting.

MASTER ELECTRIC MOTORS

THE MASTER ELECTRIC COMPANY • Dayton 1, Ohio


NOT LOADED
COLD POSITION
HOT POSITION
FREE LENGTH HANGER WITHOUT PRECOMPRESSION
GRINNELL PRE-ENGINEERED HANGER WITH PRECOMPRESSION
AREA OF EXCESSIVE VARIATION
SAVES UP TO 50% HEADROOM
casings up to 30% shorter; turnbuckles 15% to 20% shorter
Without flexible support to keep high temperature piping "weightless" in the operating position, entire piping systems can be endangered. So Grinnell offers . . .

Precompressed Hangers for Safer Support of Piping

Helical coil springs are widely used in hangers for flexible support of piping which moves up or down during thermal expansion. The A.S.A. code for pressure piping requires that variable spring hangers support at least a minimum of 75% of the pipe's weight for a pipe that rises (relaxing the spring) and no more than 125% of the pipe's weight for a pipe that lowers (compressing the spring) during operation.

Precompression patented Grinnell principle

To guard against the spring's supporting force exceeding the limits of variation, Grinnell developed and patented a variable spring hanger design. The steel casing holds the spring permanently precompressed, at the threshold of the hanger's working load range. This prevents the spring decompressing into its area of excessive variation.

Pre-set is not a substitute

As a partial substitute for this patented precompression, some manufacturers insert a spacer between the top end of a free-length hanger casing and the spring to hold the spring's height temporarily within the working range during shipment and erection.

Another device requires the manufacturer to drill symmetrically opposite holes in the casing walls and insert a bolt to hold the spring's height within the working range. When these devices are removed from the hanger and discarded, the spring can decompress, resulting in high variability in supporting force.

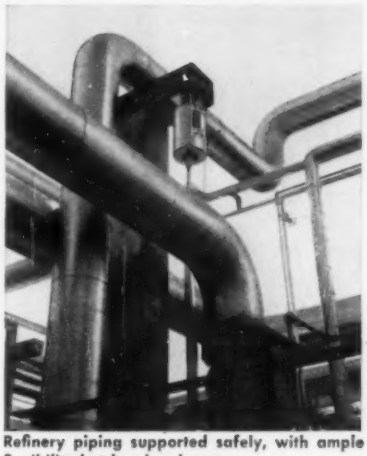
Cold-setting a universal factory service

For the erection crew to avoid having to compress the spring down to the erected position, the manufacturer can compress the spring down to this height. Grinnell can provide a cold-set bolt in precompressed hangers.

Less headroom required by Grinnell Hangers

Shorter hanger casings made possible by Grinnell's patented precompression, reduce bulk shipping weight and required headroom by eliminating undesirable height. Installation is simplified by this shorter casing and also by an integral load scale with load indicator.

Additional headroom is saved by a correspondingly shorter turnbuckle. These precompression advantages are available in short spring and double spring models as well as standard spring models.



Refinery piping supported safely, with ample flexibility but low headroom.

Available in 63 standard units

Grinnell Variable Spring Hangers are available in 21 sizes each of short, standard and double spring models . . . for maximum travel of 1¼, 2½ and 5 inches respectively within working load ranges. Load capacities extend from 43 lbs to 30,550 lbs. The maximum variation in the standard size per ½-inch deflection is 10½% of rated capacity; inversely proportional in short spring and double spring models.

For further information

If you have a pipe suspension problem, you are invited to write: — Grinnell Company, Inc., 246 West Exchange Street, Providence, R. I.

we can show you the forest because of the trees

Many times oil men feel they are in a poor position financially simply because they can't see the entire picture of their operations. Caught in the complexities of their day-to-day activities, they are unable to survey their properties in a realistic, objective manner. And as a result, many times they end up working for their creditors.

Increased operating costs spell falling profits. And that means trouble. While there is no short cut way out of this problem, The Commerce working with your legal and tax counsel can many times show you how to increase profit by reducing costs. Tighter managerial control, an analysis of costs, and recommendations for changes have increased the profit of other oil men. If your problems are similar, come to the bank that actually does know the oil business and that can help you.

E. O. Buck, vice president, Oil Loan Department

Member Federal Deposit Insurance Corporation

THE NATIONAL BANK OF

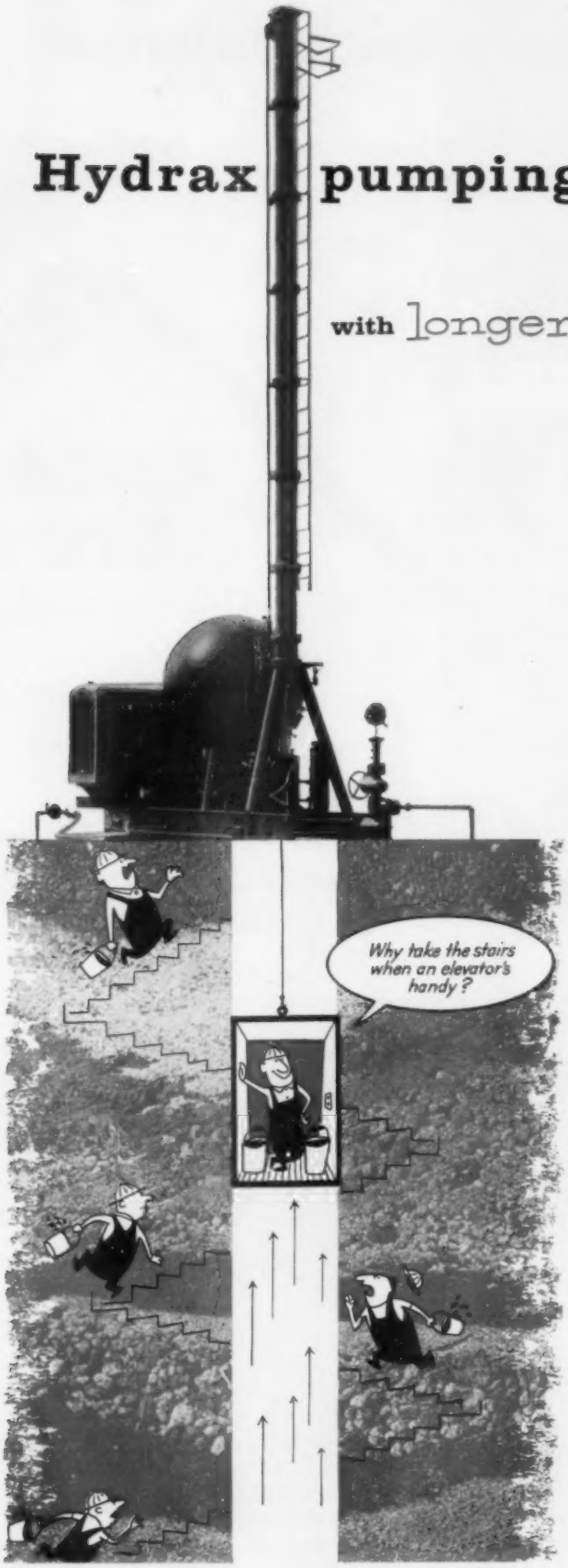
COMMERCE

Gulf Building, Houston, Texas **OF HOUSTON**

Facilities of The National Bank of Commerce Oil Loan Department are available in Wyoming, Nebraska, Colorado, New Mexico, Texas, Louisiana, and Mississippi.

Hydrax pumping units raise profits

with longer... smoother strokes



Why take the stairs when an elevator's handy?

Axelson's radically different Hydrax Long-Stroke Pumping Units take the huff and puff out of pumping deep and high-production wells. These completely hydraulic units pull more oil – and profits – to the surface with longer, slow-and-easy strokes.

And they do it with a normal stroke of 26½ feet . . . the most effective in the industry. Their seven long strokes/minute actually outproduce the thirteen strokes/minute of the biggest beam unit. There's less wasted motion in rod stretch, and volumetric efficiency is greatly increased.

The slower, smoother action of these big counterbalanced pumpers virtually eliminates sucker rod failures . . . increases rod life to eight times normal expectancy. Rod stresses can be increased as much as 30%, enabling operators to use larger bore pumps to move greater volumes of fluid. Maximum load capacity is 32,000 lb.

With Hydrax units there's less turbulence at the well bottom. No large, external moving parts at the surface means greater safety. Hydrax Long-Stroke pumpers are simple to operate . . . from a single control panel within easy reach at ground level.

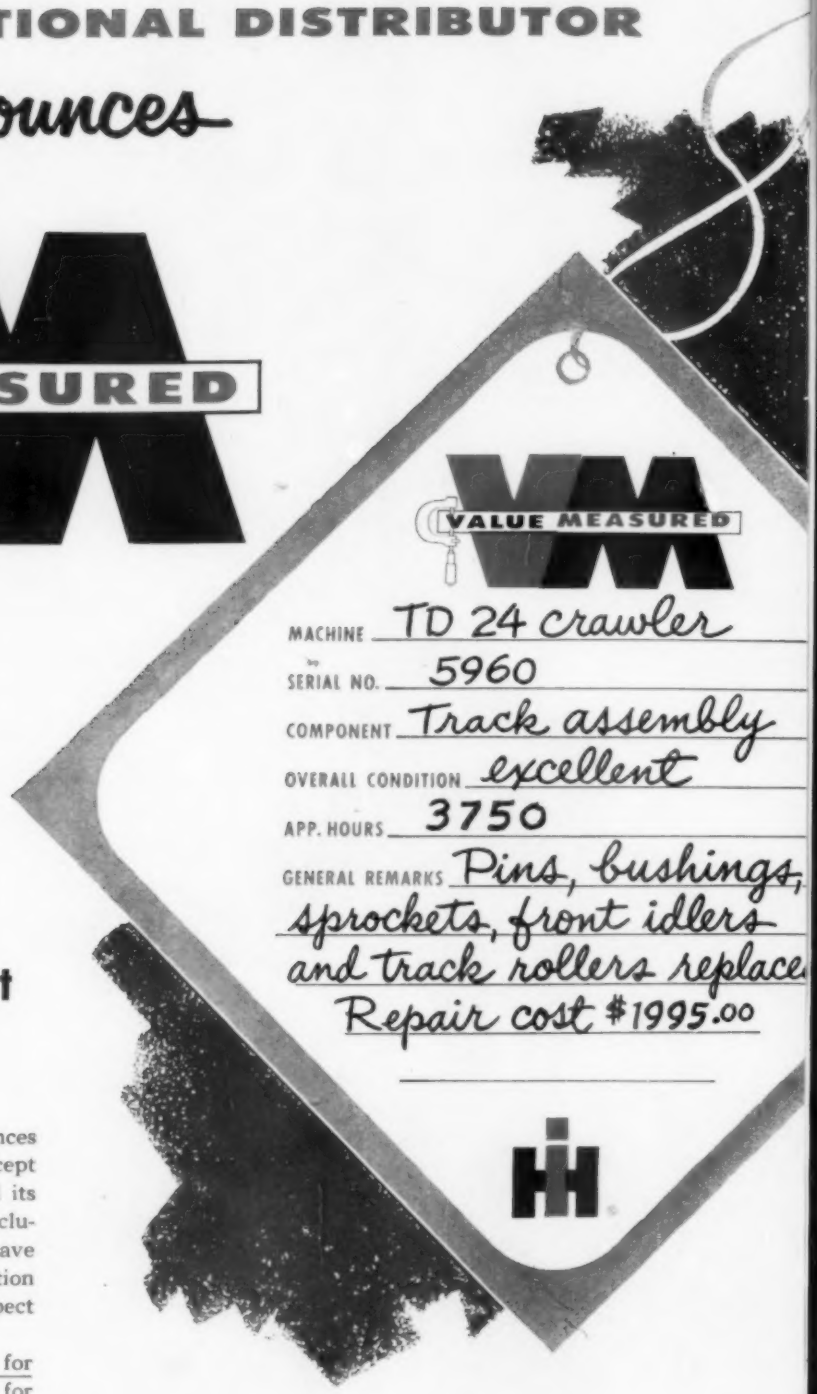
Axelson – a leader in the petroleum equipment industry since 1898 – has a nationwide sales and service organization in the field to make sure the Hydrax you order gives trouble-free service. Hydrax units are now available in 4′, 6′, and 10′ sizes. Specifications will soon be released on a new 30′ unit. For more information, call your nearest Axelson representative or write today for Bulletin O7-H-0300.

AXELSON
MANUFACTURING COMPANY
Division of U. S. Industries, Inc.
6160 South Boyle Avenue, Los Angeles 58, Calif.

YOUR INTERNATIONAL DISTRIBUTOR

proudly announces

VM
VALUE MEASURED



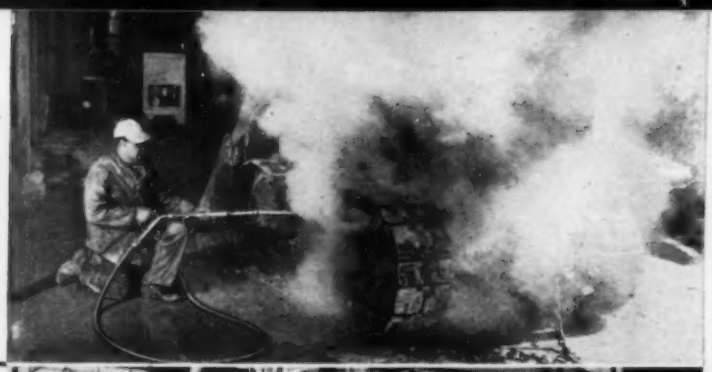
The exclusive equipment buying plan that Value Measures used machinery and its component parts before you buy!

Your International Distributor proudly announces VM... a revolutionary equipment buying concept that measures the value of used machinery and its components before you buy! Now, under this exclusive International Distributor program, you can have a reasonable answer to your most important question when buying used equipment..."What can I expect of this machine and for how long?"

The answer is supplied in two ways, not only for the over-all condition of the machine but also for all the major parts of the machine as well! And the answers are easy to get. They're all tabulated for you on big tags, (see illustration, above), which are attached to the component or near it. Each tag names the component, gives you the over-all condition of it, tells the approximate hours of operation (because parts are changed in units at different times), and shows whether the item has been repaired or replaced with a new part. The tags permit you to examine a piece of used machinery quickly, completely, and with confidence. In fact, VM – the IH Value-Measured Used Equipment Plan–does for you what you yourself would like to do to check used equipment, if you had the time and facilities.

Your International Construction Equipment Distributor has Value-Measured Used Equipment buys on his lot, now. Be sure to see him soon and find out why VM is your best way to buy used construction machinery.

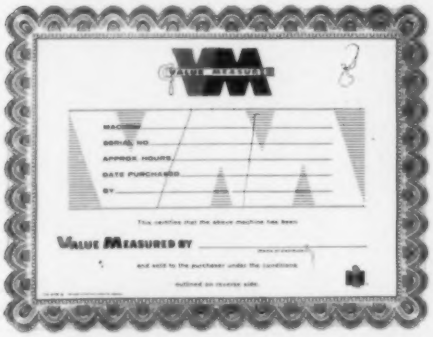
Clean-up! A Value-Measured Used Equipment buy first gets a steam bath before inspection of major parts. Clean machine reveals wear, cracks, other damages which need repair.



Check up! Dynamometer engine testing is typical of thorough inspection and testing before and after worn engine parts are replaced. Testing equipment of this type enables distributor to guarantee performance on VM equipment.

Fix up! After testing, distributor servicemen make necessary repairs and adjustments to equipment. All such repairs and their cost are tabulated on VM tags which you'll find conveniently attached to the components.

Measure up! You'll find the VM buy headquarters sign only at your International Construction Equipment Distributor. Stop here soon if you need used construction equipment...and become acquainted with the industry's newest, safest, and most economical way to buy used machinery...the VM way.



VM Purchase Certificate is your guarantee that every major working area of the used machine has been thoroughly checked and repaired, or replaced, when necessary. It also means your VM used machine is the best buy for the price.

INTERNATIONAL® CONSTRUCTION EQUIPMENT

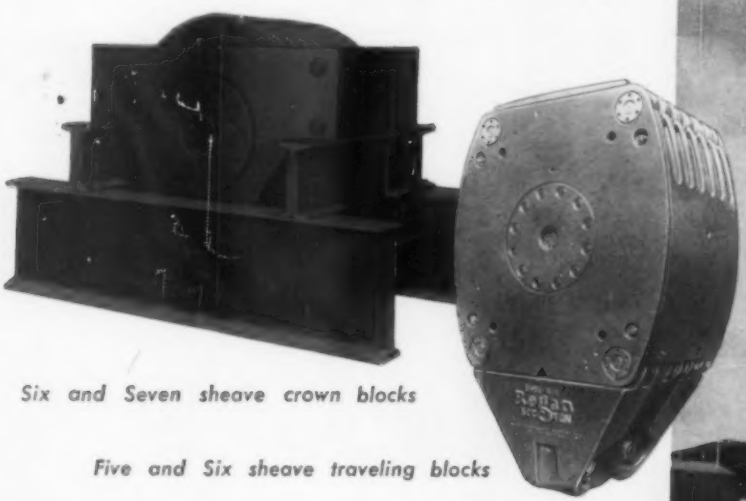
International Harvester Co., 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors... Self-Propelled Scrapers... Crawler and Rubber-Tired Loaders... Off-Highway Haulers... Diesel and Carbureted Engines... Motor Trucks... Farm Tractors and Equipment.

Regan Type M Blocks with 50" sheaves

To Speed Drilling... Reduce Wire Line Wear

Type M Regan crown and traveling blocks were designed for "double extra heavy" service, and feature dual bearings plus ball thrust bearing for each cast-steel flame-hardened-groove sheave. This insures long life and even wear in grooves, and minimum wire line wear. The Type M "traveler" is a real heavyweight, with low center of gravity for true running, fast falling blocks, and even line spooling on drum. Individual sheave beams in crown and traveler carry sheave loads and give additional rigidity to each block. Lubrication system is from either side — positive to each bearing and includes extra capacity reservoir. For your "XX Heavy" jobs, use Regan M Blocks. For further information and sure supply, "Around the Clock— Around the World", call your Mid-Continent representative.



Six and Seven sheave crown blocks

Five and Six sheave traveling blocks

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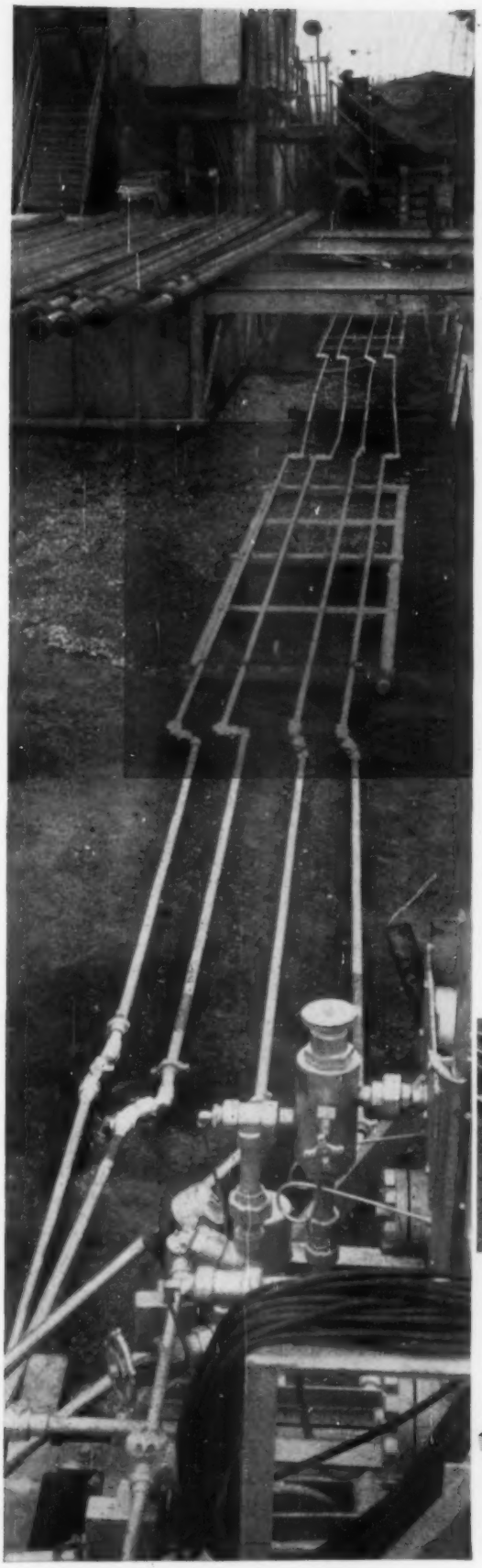
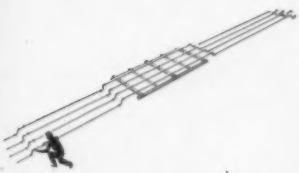


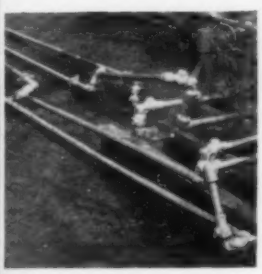
SWIVEL JOINTED ACCUMULATOR LINES CUT HOOKUP TIME 75%

SPOTTING SLED

OPENING LINES



HOOKING UP UNIONS



Situation: Connecting hydraulic piping from accumulator to blowout preventer on this California rig used to take two men well over two hours. There were delays for rethreading damaged pipe and replacing worn fittings. And keeping lines free of dirt between breakdown and rigging-up was a problem.

Solution: Searching for a faster hookup method, the veteran toolpusher in charge of the rig drew upon his previous experience with Chiksan Swivel Joints. By combining a series of Chiksan Joints with rigid piping mounted on a sled, one man now completes the entire hookup in one hour.

Benefits: The operators estimated that the savings in time alone more than paid for the Swivel Joints in less than a year. In addition to rigging time saved, wear and tear on the piping itself has been considerably reduced. And with line pressures of 1500 psi and surges up to 2000 psi, the free-swiveling Chiksan Joints absorb pulsation and vibration eliminating downtime required to replace leaky pipe fittings.

Where to buy: Chiksan Swivel Joints are available at your nearby supply stores in a full range of styles and capacities to meet every oilfield need. If you would like a drawing of the preventer line hookup described above, please write Chiksan, Brea, California, for "Bulletin ACL-1."

Free swiveling Chiksan Swivel Joints permit flexibility in positioning accumulator, absorb line pulsations and best of all, deliver years of service with only occasional maintenance.

Please Address Dept. 37

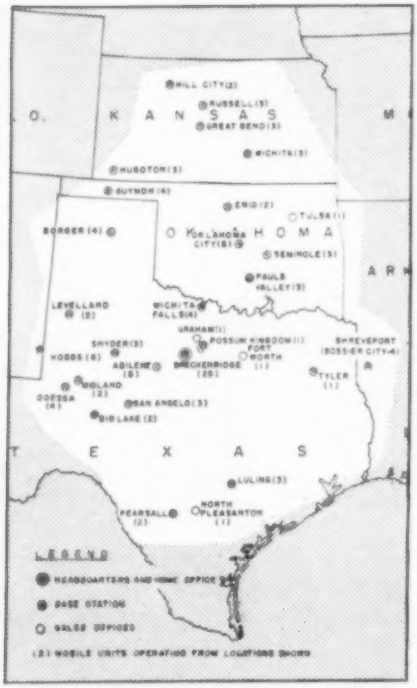
CHIKSAN

A SUBSIDIARY OF FOOD MACHINERY AND CHEMICAL CORPORATION

CHIKSAN COMPANY—BREA, CALIFORNIA
CHICAGO 5, ILLINOIS • NEWARK 2, NEW JERSEY

Well Equipment Mfg. Corp. (Division), Houston 1, Texas
Subsidiaries: Chiksan Export Company • Chiksan of Canada, Ltd.

Chemical Process speeds oil field service in 5 states



Chemical Process' G-E radio system has grown right along with the company. Today it includes 25 base stations and 106 mobile units. Authorized General Electric service stations provide complete coverage in the field.

Overhead cut with General Electric two-way radio

Chemical Process Division of BJ Service, Inc. treats about 11,000 wells a year in five states. "Our rolling stock drives 500,000 miles or more a month and I don't see how we ever did without radio," says Mr. E. C. Burnett, Supt. of Communications.

One of the earliest users of General Electric two-way radio, Chemical Process knows how economical General Electric radio is to maintain. The new Progress Line with plug-in chassis saves them even more money through faster servicing. Either a transmitter or receiver can be replaced in five minutes right in the vehicle, using only a screwdriver. And with 50¢ worth of parts, you can even change from wide to narrow band reception (pioneered by General Electric).

Only General Electric gives you plug-in chassis, dependable communication-type tubes and controlled reluctance microphones for sharp voice transmission—*all at no extra cost.*

Look for your G-E communications consultant under "Radio Communications Equipment" in the Yellow Pages, or write: General Electric Company, Communication Products Dept., 1877-1, Syracuse, N. Y.

GENERAL ELECTRIC

By B. R. Dixon,
Johnston Testers

FOR MORE INFORMATION AT THE BOTTOM OF YOUR WELL

Important points on double shut-in pressures

"What is the main advantage of double shut-in pressure readings?" That's a question often asked by those who have not yet tried this newest method of drill stem testing.

Actually there are four main advantages of the double shut-in pressure method:

1. Maximum formation pressure build-up in shortest time.
2. Comparison of reservoir build-up pressures before and after test.
3. Two separate chances to obtain reservoir pressure.
4. The measuring of the true equilibrium pressure prior to producing the formation provides a virgin pressure measurement and more accurate data.

Perfected by Johnston Testers, this new technique requires only a simple rearrangement of the test tool assembly. By placing a valve above the main or hydraulic valve, a specified volume of air is trapped between these two valves. This volume of air is called the "air chamber."

As the purpose of the air chamber is to relieve the mud pressure trapped below the packer, the secret of success of double shut-in testing is accurate use of this air chamber. Best results have been obtained when volume of the air chamber is about 10% of the volume of mud below the packer.

In the past, it has been common to calculate the air chamber to the nearest 30-foot pipe length. This lack of accuracy has often caused a failure to record the maximum initial shut-in pressure.

To overcome this problem, and to do away with complicated mathematics, Johnston has developed an "air chamber alignment chart." By simply drawing straight lines between known figures, the amount of air chamber needed can be calculated quickly and accurately.

Complete information on double shut-in testing is available from Johnston Testers, Houston, Texas. Write today for complete descriptive folder.

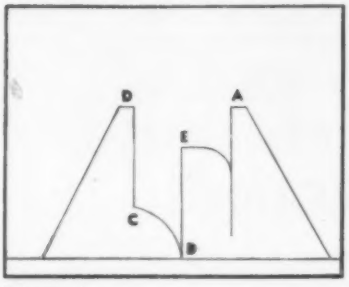


Figure 1
Example of a chart on an interval that has good permeability. The initial shut-in shows the formation pressure before the reservoir has been disturbed. The rapid build-up of the flow curve from "B" to "C" indicates rapid entry of fluid into the drill pipe. In this case the formation gave way allowing the hydrostatic pressure to stop the test. If the initial shut-in had not been taken another test would have been necessary in order to determine the reservoir shut-in pressure.

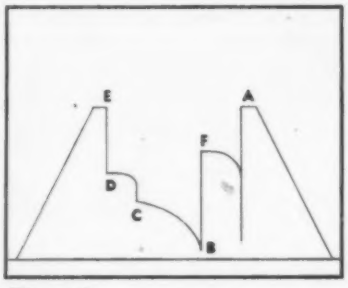


Figure 2
Example of a test in a very small reservoir. The initial shut-in pressure indicates a good initial pressure and the flowing curve shows good recovery, yet the final shut-in curve has almost leveled off to a point much lower than the initial reservoir pressure. This indicates that the reservoir is very small and even the short producing time of the drill stem test has partially depleted it. A follow-up test of the same interval is advisable.

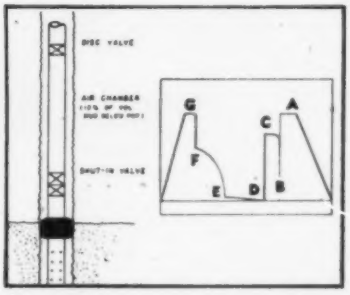


Figure 3
Testing tool assembly for double shut-in pressure readings which permits a limited fluid withdrawal. By placing the disc valve above the main or hydraulic valve so that a specified volume of air is trapped between these two valves.

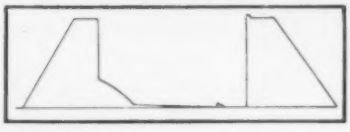


Figure 4
Well not capable of producing fluid fast enough to fill up air chamber and cause pressure build-up.

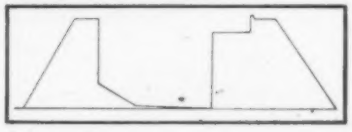


Figure 5
Mud did not expand enough to get pressure draw-down below the formation pressure.

B. R. Dixon, M.E.
Sales Engineer
Johnston Testers
Dallas, Texas

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A Subsidiary of Schlumberger Well Surveying Corporation

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HOUSTON, TEXAS

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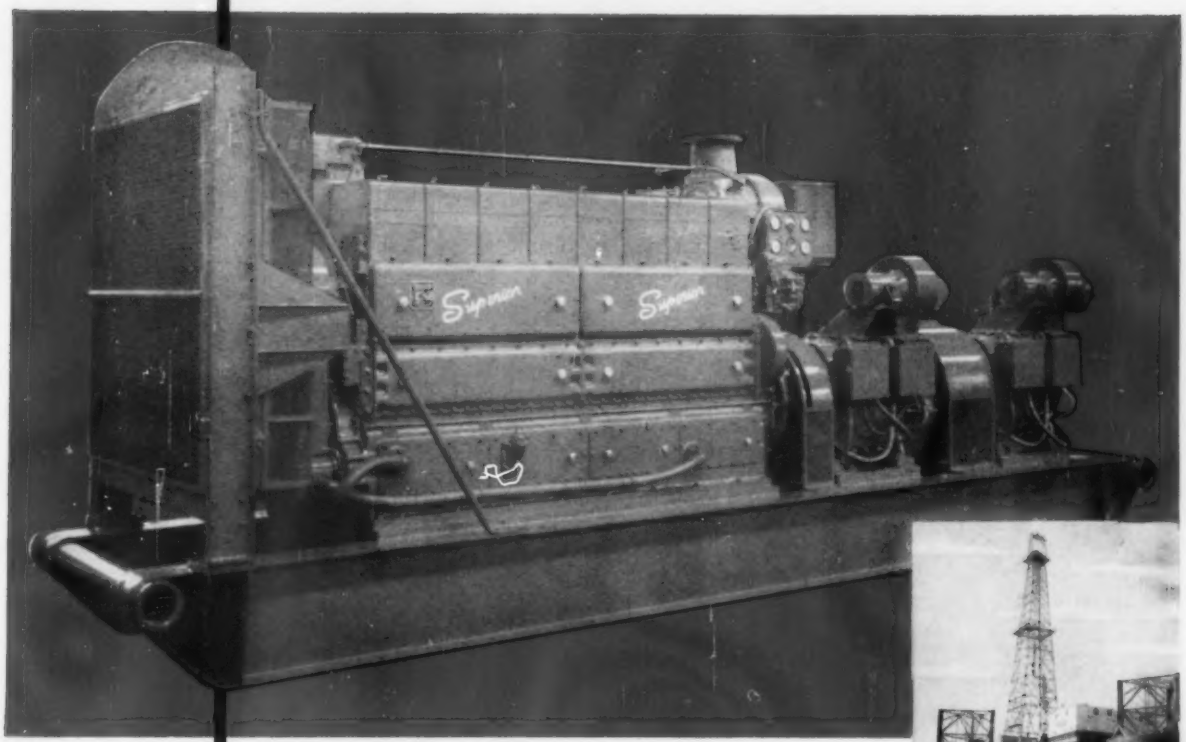
That's why Dynalogs respond almost instantly to the slightest change in a process variable, with a sensitivity of 1/100 of 1% of scale . . . accuracy of ¼ of 1% of scale. It's also the reason they're the maintenance man's dream. About all he does is supply ink and charts!

Dynalogs are used with any primary element—resistance, voltage, capacity, inductive. They perform with effortless accuracy, even on control and recording problems that conventional balancing-type instruments can't handle. For the complete story, write for Bulletin 20-10. **The Foxboro Company, 607 Neponset Ave., Foxboro, Mass., U.S.A.**

*Reg. U. S. Pat. Off.

Dixilyn Drilling selects . . .

WHITE'S Superior Diesel-Electric



Lighter, extremely simple, more powerful drilling rig power plant!

Dixilyn Drilling Corporation of Odessa, Texas wisely chose White's Superior Diesel-Electric power for drilling operations to over 25,000 ft. deep from their LeTourneau mobile tripod platform, off the Louisiana Gulf Coast. The platform's 175 ft. spuds will permit drilling in approximately 105 ft. of water. The complete power package, including three 834 h.p. Superior engine-generator sets, will dependably provide a total of more than 2,500 h.p. From simplified controls, the driller can direct 2,000 h.p. to a National 1625 drawworks, or 2,000 h.p. to the mud pumps. Operational headquarters for the rig will be Morgan City, La.

More power for faster, deeper drilling—land or offshore, plus smoother overall performance, quicker response and extreme simplicity in arrangement and operation are the results of White's new important advancements and design refinements.

Components consist of 2 or more engine-generator sets, a minimum of 3 drive motors, and simple controls. White's well-known Superior oil field engine and rugged 300 to 550 kw generators in tandem make up an engine-generator set. Total weight of one set alone is almost 8 tons lighter than comparable units!

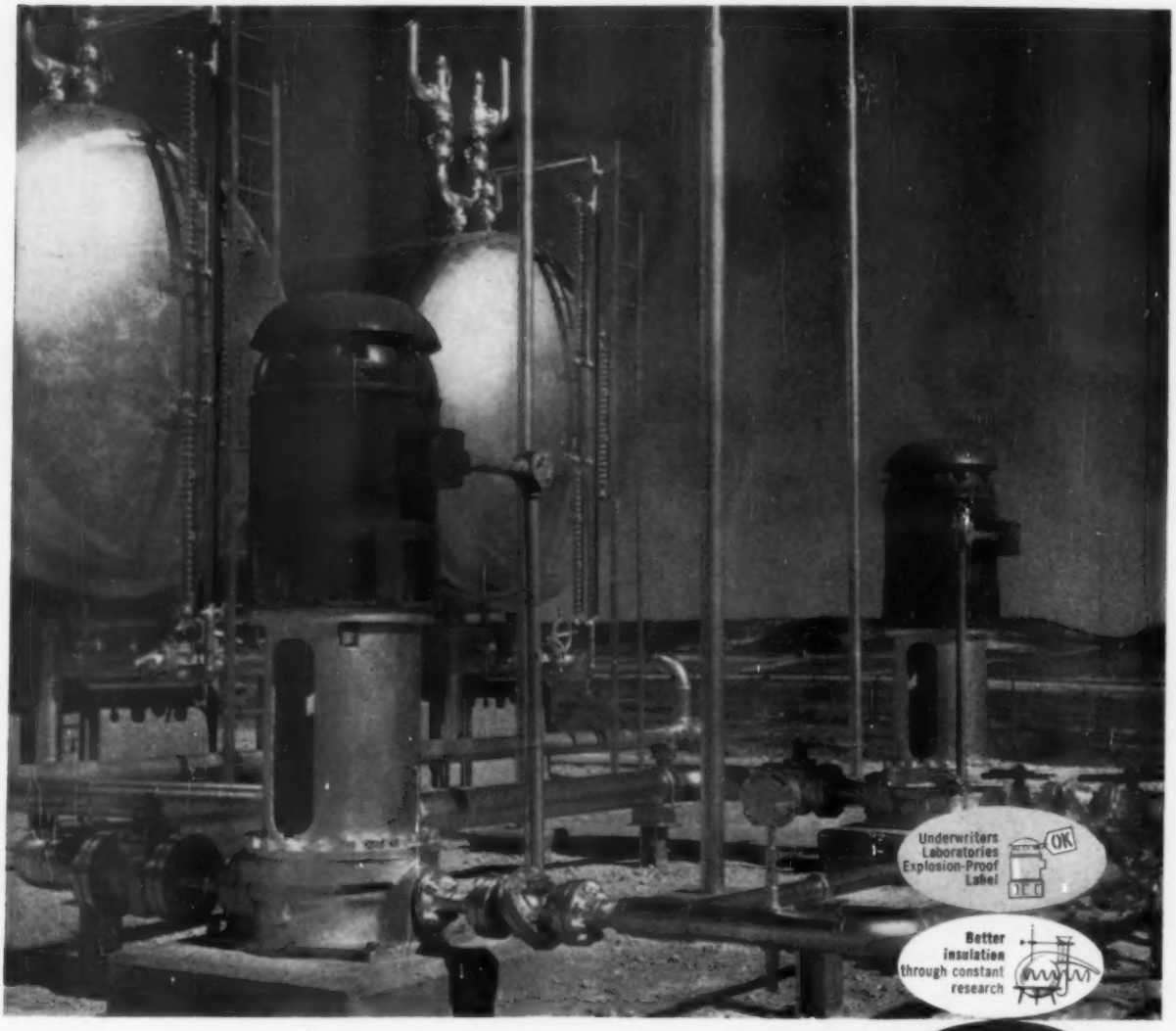
Power concentration in the heavy-duty drive motors also achieves simplicity, compactness and lighter weight. Largest drive motors are rated 1000 h.p. continuous and 1250 h.p. intermittently. This permits use of only one motor for the drawworks and one for each mud pump. Multiple motor linkages are unnecessary and controls are greatly simplified. All components are stocked, standard production items, ready for prompt delivery.

Get complete information from leading rig manufacturers, White's oil field representatives, or through White Diesel Engine Division.

White Diesel

WHITE DIESEL ENGINE DIVISION
THE WHITE MOTOR COMPANY

Plant and General Offices: Springfield, Ohio



Here's dependable all-weather power

Louis Allis vertical motors are designed for outside petroleum installations

Here's a pump drive keyed to match the particular specifications of the petroleum industry.

Louis Allis vertical solid-shaft motors are explosion-proof for operation in hazardous locations, and corrosion-resistant to ward off both the etching acids in cat-cracking plants and the corroding action of salt spray at sea-exposed installations.

Tough, impervious insulation plus well-designed fully-enclosed construction give ample protection against weather, including dust- or rain-storms.

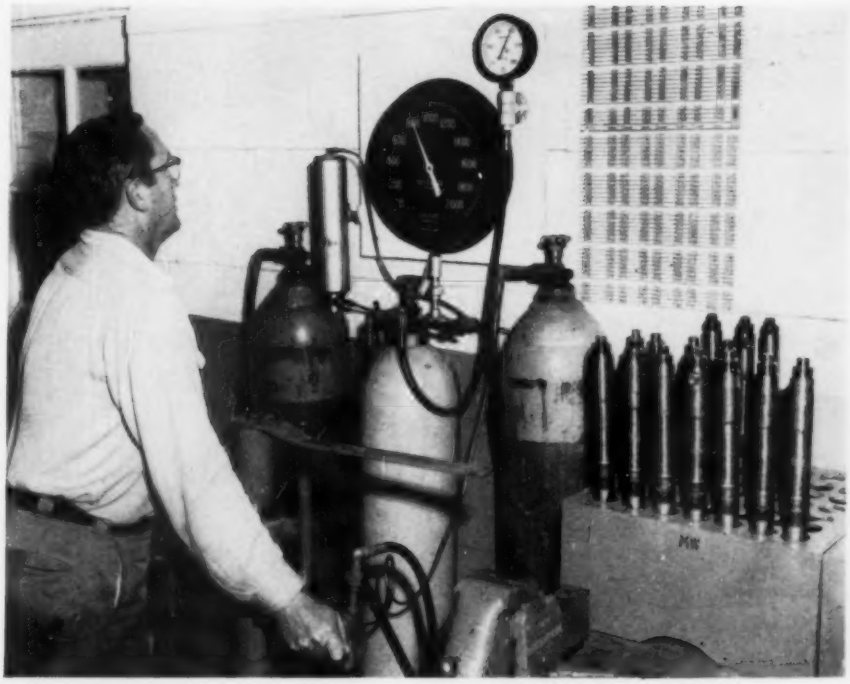
These motors are no problem for maintenance men, either. Easily mounted and wired up, they require little care afterwards. Tested quality bearings and ample lubrication reservoir keep them trouble-free. The locked bearing construction assures long life.

Louis Allis has a complete line of Explosion-Proof motors, with speeds to 3600 rpm., and sizes up to 600 hp. Ask for Bulletin 800 at your nearby Louis Allis District Office or write The Louis Allis Co., 449 East Stewart Street, Milwaukee 1, Wisconsin.

LOUIS ALLIS

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES

Typical A Valve Test Case History — No Pressure Loss



TYPE A FLOW VALVE

GUIBERSON'S

Type A Flow Valves are Proved Perfect Before Shipping

Every Guiberson flow valve is pressured, then put through periodic opening and closing tests to assure operational efficiency. Each valve is electronically checked with a leak detector so sensitive it detects leaks as small as one ounce per hundred years. Guiberson valves are known to be perfect before shipping.

This unique method of quality control is the reason why Guiberson flow valves have built-in reliability.. costly pulling jobs for valve repairs are cut to the minimum. It's the reason why experienced operators say these valves have the lowest number of returns in the industry.

Guiberson's Type A Control Valves produce continuous or intermittent flow with only surface adjustment. Designed and engineered for superior performance, with tungsten carbide ball and seat that last for years. Corrosion and erosion resistant construction throughout — no rubber, no plastic, no O-rings to deteriorate.

Guiberson's Type AW Valve Is Available for Wire Line Installations. The Type AW, with integral check valve and special mandrel, lets you run in and retrieve on wire line.

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THE GUIBERSON CORPORATION

ESTABLISHED 1919
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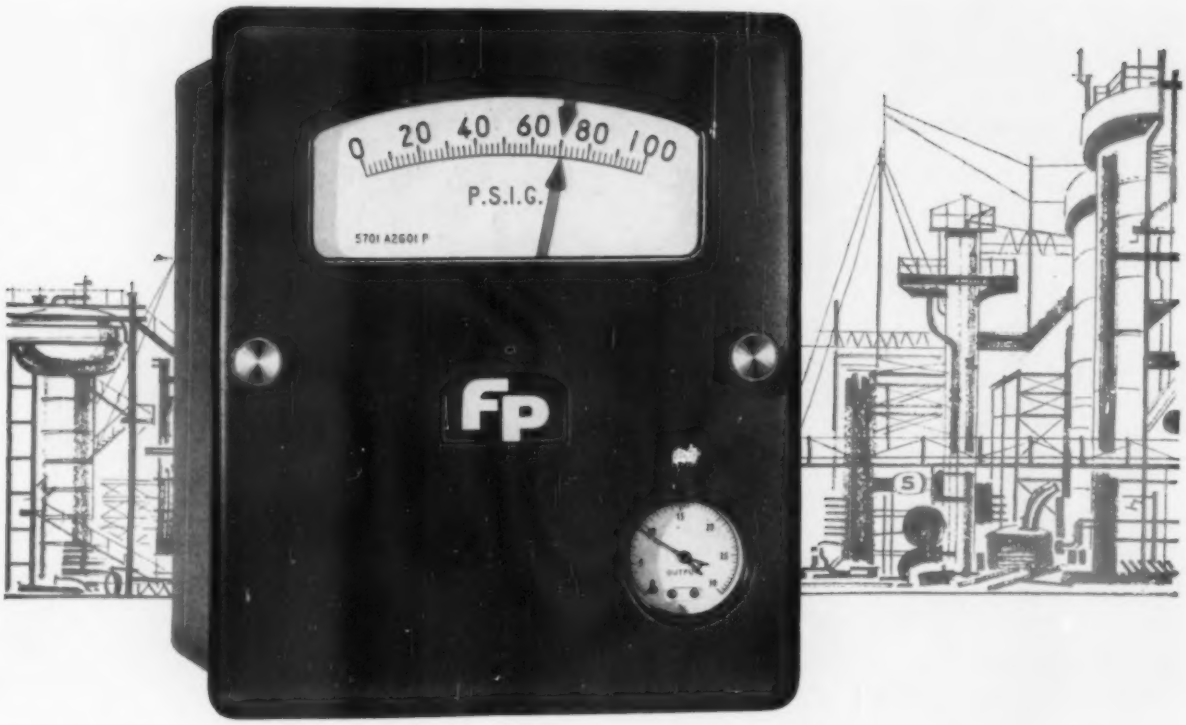
ONE OF THE DRESSER INDUSTRIES

Sold by Oil Field Supply Stores Everywhere



new small instruments in fiber glass cases indicate . . . transmit . . . control temperature or pressure

NOW . . . instruments as corrosion-resistant as the equipment they control! Every instrument in Fischer & Porter's new 1450 Series is housed in a fiber glass reinforced polyester case resistant to acids, alkalis, salts, solvents, dust, and weather. You can place indicators, transmitters, and controllers wherever you want—inside or out—without regard for corrosive fume and splash. The protection is built right into the housing . . . nothing to wear away or scratch off . . . no coatings to renew. The first such equipment available for process instrumentation, Series 1450 brings a new flexibility and freedom to instrument installation.

There's no way for corrosive atmospheres to reach the working instrument. Every exposed part is either plastic or 316 stainless steel. And a polyvinyl chloride gasket provides a positive seal against dust and moisture entry.

F&P has engineered the unique new 1450 Series housing for operation and maintenance ease. The entire instrument can be removed from the case if desired. Zero adjustment and range changes are easy. A plug in the removable door provides access to the adjustment screw for the optional external set point.

Field tested over a one year period, the 1450 Series is available NOW on four week delivery schedules.

SERIES 1450

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Temperature Range:

minus 400F to plus 1000F.

Pressure Range:

30" Hg vacuum to 5000 psi
As pneumatic receivers, 1450 instruments accommodate 3 to 15, 3 to 18, or 3 to 27 psi signals.

Instrument Options:

Single indicator • dual indicators • single indicator with dual alarms • indicating controller with any mode of control • indicating transmitter. Transmitter can provide pneumatic outputs, resistance outputs, or differential transformer outputs.

Controller Options:

- universal controller with on-off, proportional, differential gap, and manual reset
- wide band proportional
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Mounting:

Suitable for surface, pipe, or panel mounting. Panel cutout size is 8¾" x 10¼".

For complete data write Fischer & Porter Co., 3177 County Line Road, Hatboro, Penna.

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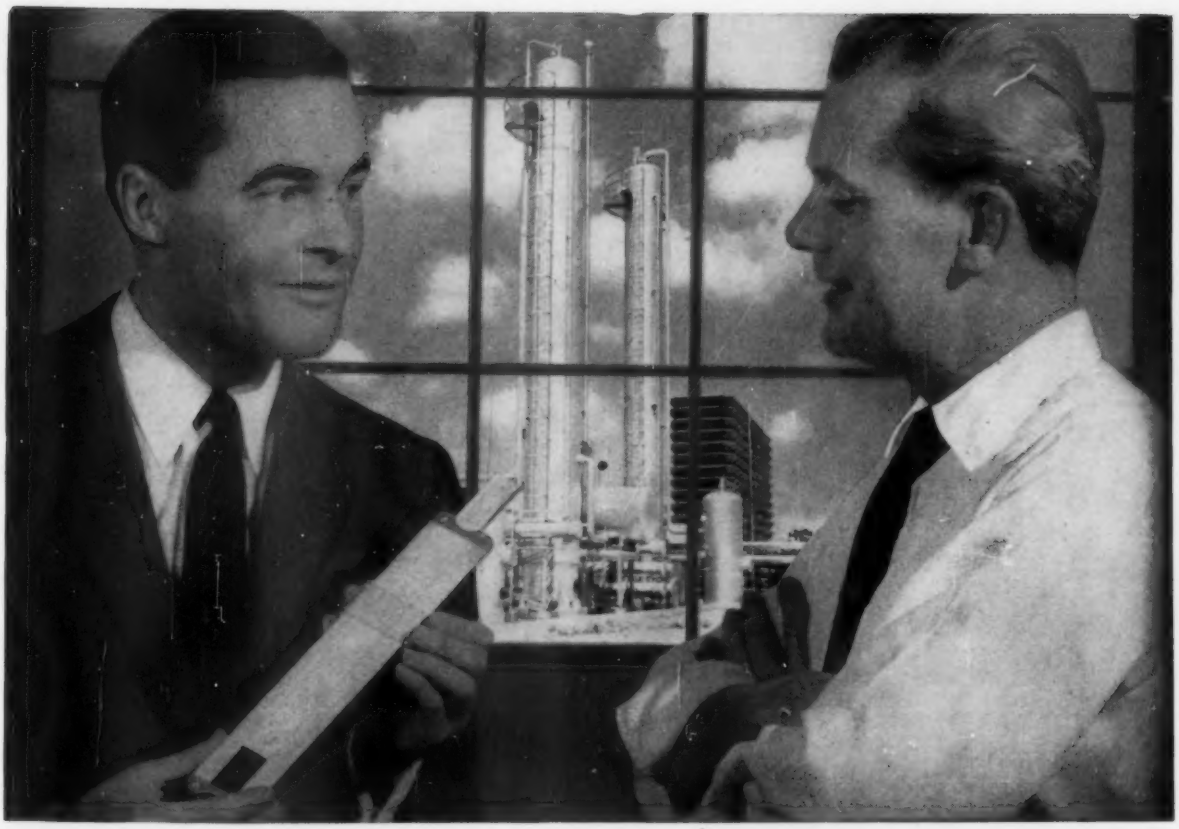
Complete Process Instrumentation



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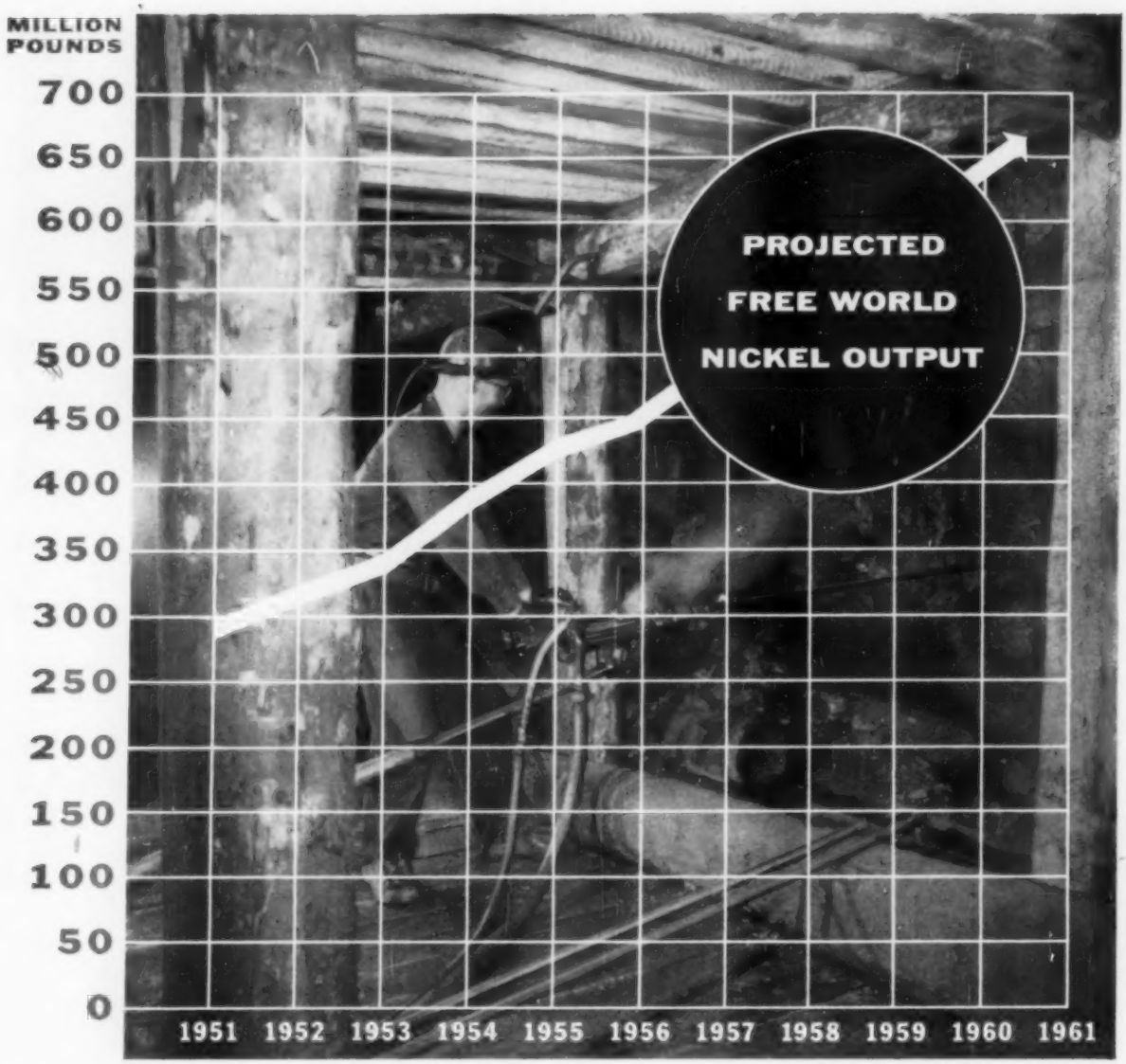

Another 50% advance in nickel industry's production capacity

Paced by Inco-Canada's new developments in Manitoba, producers put 1961 Free World nickel output at 650-675 million pounds a year—up 130% over 1951

In 1951, the nickel industry of the *Free World* produced about 290 million pounds of nickel.

Last year, the over-all output of the industry set a new record high of 450 million pounds.

This was an expansion of more than 50% in five years: a substantial production boost that indeed benefited industry, but only after vital defense and government stockpile needs were given preference.

New Inco-Canada developments help set new goals

Right now Inco-Canada, with years of exploration behind the project, is pushing construction at its new Manitoba mines: developing in the far North a new, big-tonnage nickel-producing area.

In Ontario, at the same time, Inco-Canada is continuing to expand its Sudbury capacity.

In 1961, this should lift Inco-Canada's nickel output to 385 million pounds a year. A hundred million more than in 1956!

With the steadily increasing capacity of all *Free World* producers, in the next four years nickel production should be lifted to the all-time high of 650-675 million pounds a year.

With 1961 capacity anticipated at more than twice what it was in 1951—and with continuing exploration—nickel users are assured of more nickel in their future.

The International Nickel Company, Inc., New York 5, N.Y.

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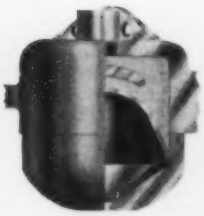
INCO **International Nickel**

The International Nickel Company, Inc., is the U. S. affiliate of The International Nickel Company of Canada, Limited (Inco-Canada)—producer of Inco Nickel, Copper, Cobalt, Iron Ore, Tellurium, Selenium and Platinum, Palladium and Other Precious Metals

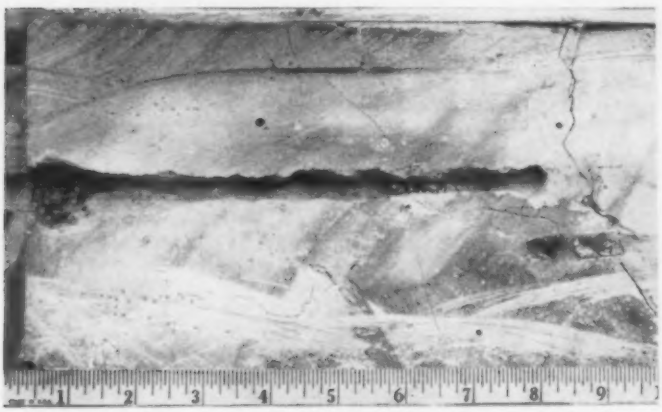


WELEX LINK-JET*

Leaves 40% Less Debris

The Welex 1-11/16" Link-Jet, the newest of the Welex jet perforators, has been designed to give more penetration with less debris than any other type tubing gun available. Engineered for use in small I. D. casing liners and tubing, the advantages of the Welex Link-Jet are many:

- Forty percent less debris than any type tubing gun.
- Greater penetration and hole size than any fixed-type tubing gun.
- Extreme flexibility permits passage through tight spots in casing and tubing.
- Elimination of debris from perforation.
- Bottom firing insures sure detonation of string.
- Unique design permits interval to be skipped at minimum expense.
- Welex Dyna-Jet principle in charge assures greater hole volume.
- Strong, light-weight construction permits perforation of large shooting zones in one run.



Welex 1-11/16" Link-Jet shot in ½" of fluid into ⅜" steel plate and 14-day cement to give .40" entrance hole and 8" penetration.

WELEX 1-11/16" LINK-JET
Designed for use in Small Liners and Tubing

*Trademark of Jet Research Center, Inc.

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High Output at all Operating Speeds

Metal High Tension Outlet Plate and Feed-through Condenser on Shielded Magnetos

The reputation of Bendix* in the field of ignition is truly unmatched. From the history-making flight of Lindbergh to today's fastest jets, the aviation industry has always looked to Bendix for the latest and most efficient ignition equipment. Likewise in industrial ignition Bendix has set new standards of performance in applications ranging from small outboard motors to the largest industrial engines.

That's why the introduction of this new Bendix S-400 series of magnetos is of such great importance. Here is a magneto that incorporates all of the improvements and refinements of modern ignition design.

Built to aircraft precision standards the new S-400 series is especially rugged so as to deliver trouble-free operation during long periods of service.

It is available in both four- and six-cylinder flange-mounted models in weatherproof, unshielded and radio-shielded versions.

For the important jobs where continuous top performance is a must, the new Bendix S-400 series magneto is the logical choice. Why not write today for complete details and specifications of this modern industrial engine magneto.

SCINTILLA DIVISION OF BENDIX AVIATION CORPORATION, SIDNEY, N. Y.
Export Sales and Service: Bendix International Division, 205 East 42nd St., New York 17, N. Y.

*TRADEMARK

Scintilla Division
SIDNEY, N. Y.

Bendix
AVIATION CORPORATION

For the deepest wells considered today:

Timken® seamless steel tubing, with yield strength of 125,000 psi!

TIMKEN® seamless steel tubing can be furnished with a yield strength of 125,000 psi —20% stronger than the strongest grade called for in API specification 5A. Able to withstand internal pressures up to 15,000 psi, Timken seamless steel tubing is strong enough for the deepest wells being considered today.

Whatever your specific oil well tubing problem, Timken seamless steel tubing provides a ready solution. You may order from a wide variety of sizes and analyses, some of which are chosen for corrosion resistance, and all are ductile when properly heat treated.

Timken seamless steel tubing is already in use in several extremely deep or high pressure wells. Results have been highly satisfactory. For more than 24 years we have been making high pressure seamless tubing for many other special requirements.

FREE ENGINEERING STUDY . . . Get your free copy of "Timken Oil and Gas Well Tubing", a study of various alloys for high strength and corrosion resistant tubing, made by Timken Company metallurgists. Write to: The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN *Fine Alloy* **STEEL**

TRADE-MARK REG. U.S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING

One of Many Reasons Why...

Chain Drive is Superior to Gear Drive in Mud Pumps!

When Gears run together under load as in a mud pump drive, a *sliding action takes place between the teeth that might be called a "scouring action."* Under heavy load this tends to rub small flakes of metal off the teeth, particularly if there is even the slightest bit of sand or grit in the lubricant. When these metal flakes get in the oil they are carried back again into the gear teeth where they intensify the wearing process, until it is not long before the gears are completely worn out. And in some pumps this same oil is used to lubricate the bearings, and of course either sand or metal flakes are highly destructive to either plain or anti-friction bearings.

No Sliding Action

In the Wilson Chain Drive Mud Pump no sliding action, *only a rolling action takes place between the sprockets and the chain.*

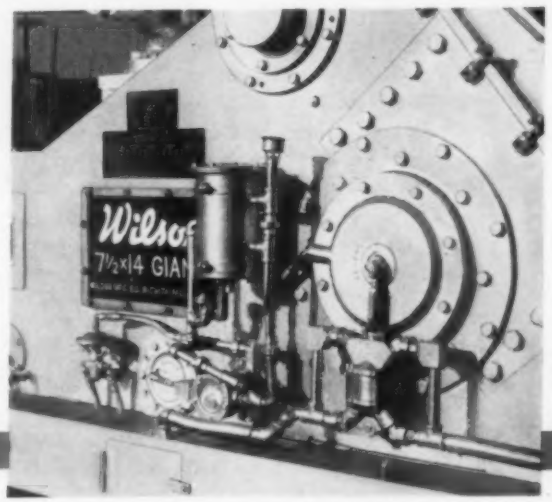
While it is highly desirable to have the oil as free from sand as possible, a small amount of sand is not nearly as destructive to a chain drive as it is to a gear drive. This is *one of the reasons why Wilson uses a chain drive instead of gears.*

Wilson Oil Filtering System

In the Wilson Pump the oil is first passed through a strainer, then it goes through a filter where even fine particles of sand or other foreign matter are removed before the oil is forced into the bearings, etc. Thus *all bearings and wearing parts are pressure lubricated with clean filtered oil, and should have a long trouble free life.*

Trouble Free–Efficient

Wilson Engineers have gone all-out to give the industry a trouble-free pump that will mean longer and more efficient service with an absolute minimum of maintenance. The Wilson Chain Drive Mud Pump offers the operator real pump economy with more NEW and ADVANCED ENGINEERED features than any other pump on the market. Investigate the Wilson now and see for yourself!



Piston rod lubricating pump. Power end lubricating oil pump and filter.

BE MODERN — BUY WILSON

FOR COMPLETE INFORMATION ON
WILSON GIANT "CHAIN DRIVE" MUD PUMP
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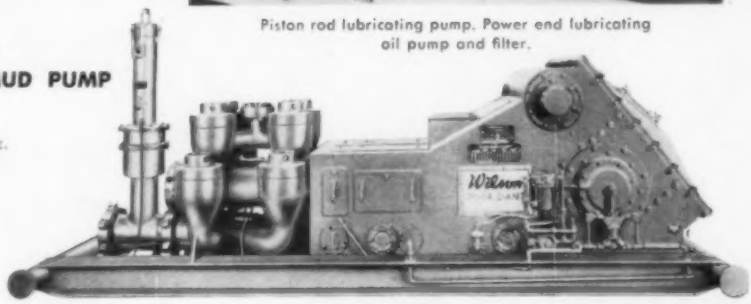


DU PONT *Petroleum Chemicals* NEWS

Number 77 in a Series of Bulletins for the Petroleum Industry

JULY 1957

Sludge problems in residual fuels minimized by Du Pont additive

ASSISTANT GENERAL MANAGER . . . ORCHEM

DR. WILLIAM C. KAY is Assistant General Manager of the Organic Chemicals Department of the Du Pont Company.

He started work with Du Pont as an industrial engineer at the Chambers Works in 1934. He became project engineer in 1939, and joined the neoprene manufacturing organization as chief supervisor in 1941.

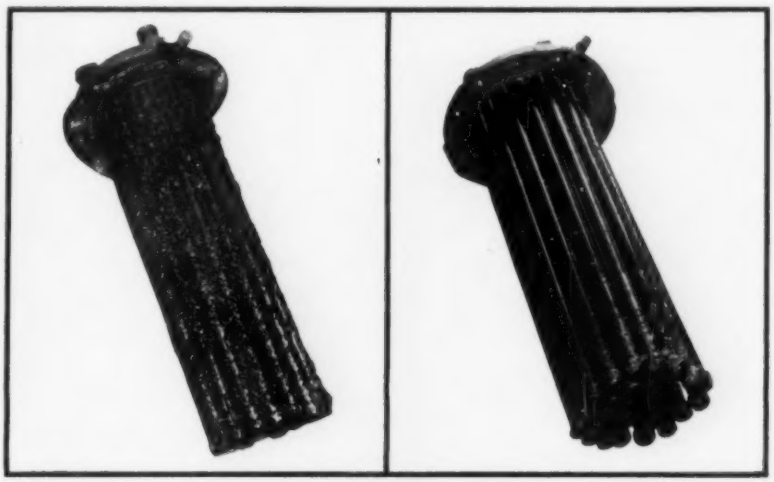
In 1943, Dr. Kay was assigned to the atomic project at Oak Ridge, Tennessee, as production superintendent. From there, he moved to the Hanford Works plutonium project in Washington. He was named Process Manager of the Du Pont Grasselli Chemicals Department in 1947.

Dr. Kay in 1950 joined the Explosives Department as Director of Manufacturing for the Atomic Energy Division. He assumed the same position in the Organic Chemicals Department in 1955. His appointment as Assistant General Manager occurred at the beginning of this year.

Dr. Kay earned his B.S. and Ph.D. degrees, respectively, at the University of Minnesota and M.I.T.

Sludge-packed systems cleaned and KEPT clean

It is, of course, a well-known fact that residual fuels too often cause serious problems. Being the "bottom of the petroleum barrel," they contain, in concentration, all the impurities from the lighter oils which have been distilled off.



PREHEATER TUBE-FOULING . . . solved by FOA-2

TO REVIEW THE PROBLEM . . .

Insoluble sludge is likely to form in residual fuels—in storage, in transit or in use. That, briefly, is problem No. 1.

Problem No. 2: Residual fuels, when blended, are often incompatible. Insoluble sludge is likely to form.

Du Pont Fuel Oil Additive No. 2 solves both problems.

Sludge cure

When sludge forms, trouble starts in the form of clogging. Many times nothing short of costly major "surgery" will start the oil flowing. So tank walls are cut through, sludge is removed mechanically, and the hole is patched up.

Oftentimes it is found that fuel system parts, filters, strainers, nozzles, preheater tubes and shells, have become clogged. While mechanical cleaning sometimes restores their functions, expensive replacements are sometimes necessary.

With these corrective measures going on, *downtime* is mounting, and labor costs are keeping pace.

Many other residual fuel users know that such an operation isn't necessary, that FOA-2 would have cleaned the tanks and parts, restored operation of the system. No cutting into tanks, no cleaning or parts-replacement, no heavy labor expense. Downtime? Greatly reduced.

ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

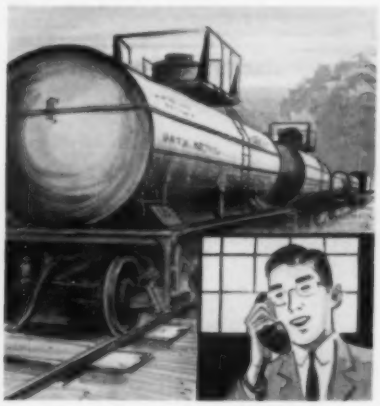
OVER

DUPONT *Petroleum Chemicals* NEWS

Du Pont is always prepared to meet your emergency TEL needs

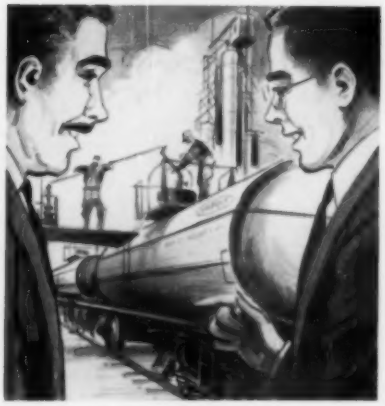
REFINERY SUPERINTENDENT:

We're in a jam. Our next regular TEL delivery is not due for another 10 days. But our refinery is gearing up to meet an unexpectedly heavy demand . . . and we don't have enough TEL to do the job.



DU PONT REGIONAL SALES OFFICE MANAGER:

Don't worry about it. We have several tank cars of TEL on a siding only a few miles from here. We can get a couple of cars over first thing in the morning.



REFINERY SUPERINTENDENT:

The TEL cars arrived this morning. That's service . . . less than 24 hours to deliver. It's good to know we can get that kind of service when we need it.

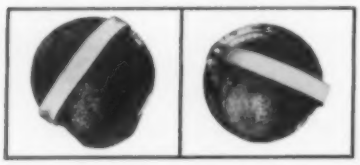
CONTINUED

Sludge problems

How it works

FOA-2 added to residual fuel attacks insoluble sludge, reduces the size of the particles which compose it, suspends them. Thus the fuel flows freely through the system. There is no blockage of nozzles, lines, filters, strainers and other parts. Oil, suspended sludge particles, and the FOA-2 burn completely.

Once a system is cleaned with FOA-2, small amounts of the additive *keep* it clean. That's because FOA-2



STRAINER-PLUGGING . . . solved by FOA-2

is a stabilizer and solubilizer as well as a dispersant.

FOA-2, being nonmetallic, is ashless and leaves no residue after burning.

Case histories prove power of FOA-2

Early this year we assembled in one technical memorandum ten case histories documenting the power of FOA-2 to clean, and to keep clean, systems fueled by "barrel-bottom" residuals.

We believe you will be interested in the ease and economy of using FOA-2, and suggest that you write for Technical Memorandum No. 317, dated January 1957.

NOZZLE-FOULING . . . solved by FOA-2

Director of Petroleum Laboratory Appointed to NACA Subcommittee

Dr. Bernard M. Sturgis, director of the DuPont Company's Petroleum Laboratory, Deepwater Point, N. J., has been appointed to the National Advisory Committee for Aeronautics subcommittee for aircraft fuels.

Subcommittees of the NACA assist in initiating research programs, advising upon technical problems, reviewing current research throughout the nation, recommending new areas of research, and coordinating research programs. NACA objectives are to anticipate the research needs of aviation and to supply the armed forces and industry with basic information for the design and production of aircraft.

DuPont's Petroleum Laboratory devotes a considerable part of its research effort to aircraft fuels and lubricants.

SALES OFFICES

Chicago 3—8 So. Michigan Ave. . . . RAndolph 6-8630
Cleveland 15—25 Prospect Ave. . . . SUperior 1-1363
Denver 2—510 Mile High Center Bldg. . . . AComa 2-2347
Houston 2—
705 Bank of Commerce Bldg. . . . . CApitol 5-1151
Los Angeles 17—612 So. Flower St. . . . MAdison 5-1691
New York 20—
1270 Ave. of the Americas . . . . . COlumbus 5-2342
Philadelphia 2—3 Penn Center Plaza . . . LOcust 8-3531
Pittsburgh 22—1 Gateway Center . . . ATlantic 1-2933
San Francisco 4—111 Sutter St. . . . . EXbrook 2-6230
Seattle 3—4003 Aurora Ave. . . . . MElrose 6977
Tulsa 1—1811 So. Baltimore Ave. . . . . LUther 5-5578
In Canada—DuPont Company of Canada (1956) Limited, Petroleum Chemicals, 85 Eglinton Ave. East, **Toronto 12**—Ontario . . . . . HUdson 1-6461
In Other Countries—Petroleum Chemicals Division, Export Sales, 7447 Nemours Bldg., Wilmington 98, Del., OLympia 4-5121, Ext. 2962

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Better Things for Better Living
. . . through Chemistry

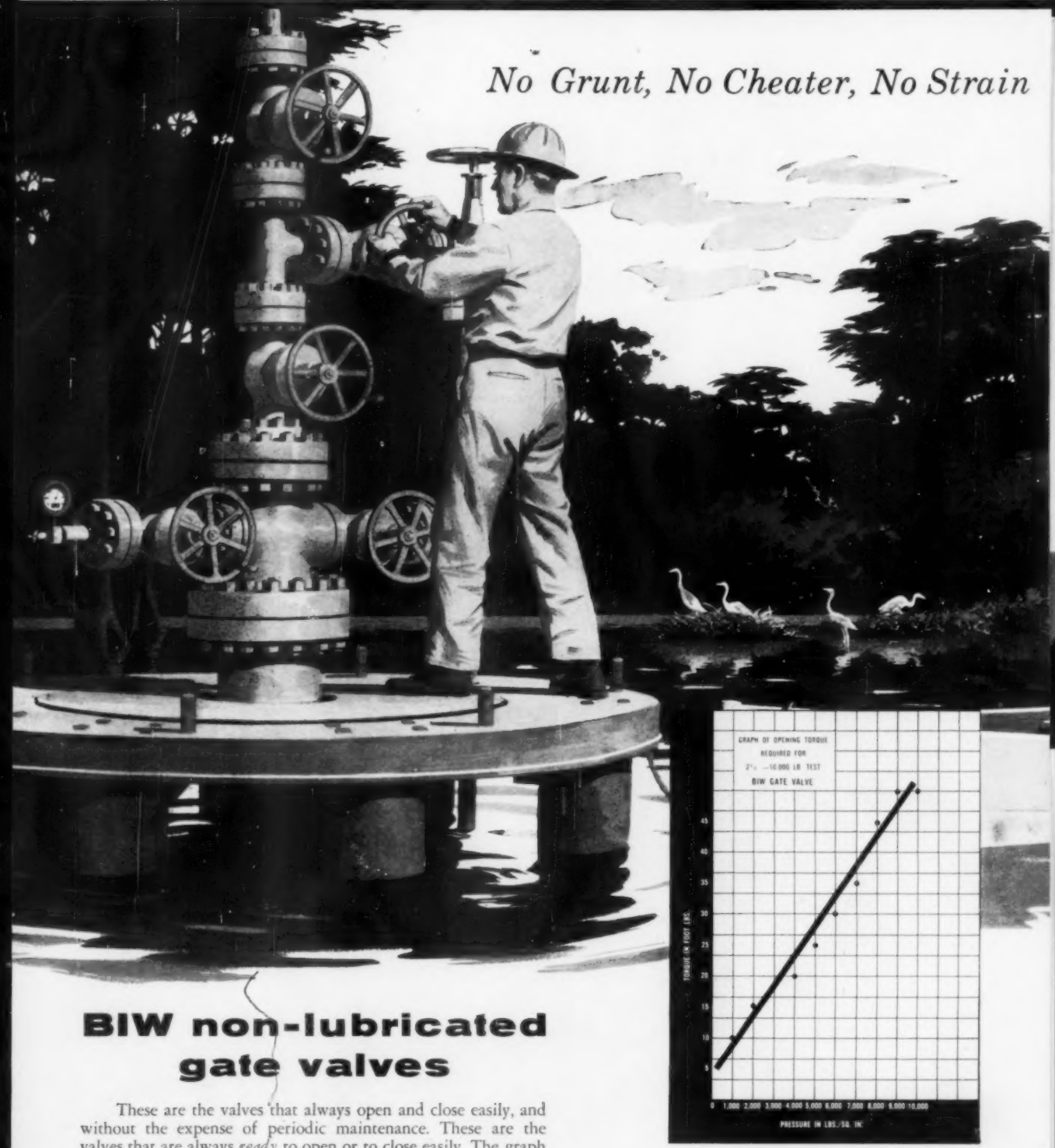
ADVERTISEMENT—Prepared for the Petroleum Chemicals Division of E. I. du Pont de Nemours & Company (Inc.)

OVER

A-4801

Printed in U. S. A.

No Grunt, No Cheater, No Strain



BIW non-lubricated gate valves

These are the valves that always open and close easily, and without the expense of periodic maintenance. These are the valves that are always *ready* to open or to close easily. The graph shows the low torque required for operation *under pressure.*

The BIW non-lubricated gate valve frees you from the problems of maintenance. Once in, you can forget them. You can be sure that the tight metal-to-metal seat will hold. You can depend on the simplified design to give you years of trouble-free service. More than 35,000 BIW valves in the field are doing their best right now. Get the best in maintenance-free, trouble-free valves for your wells.

ALCO specialists are available to show you the BIW Valve and the entire BIW Christmas tree. Or write ALCO Products, Inc., Petroleum Industry Equipment Division, Dept. BV-3, Bank of the Southwest Building, Houston, Texas.

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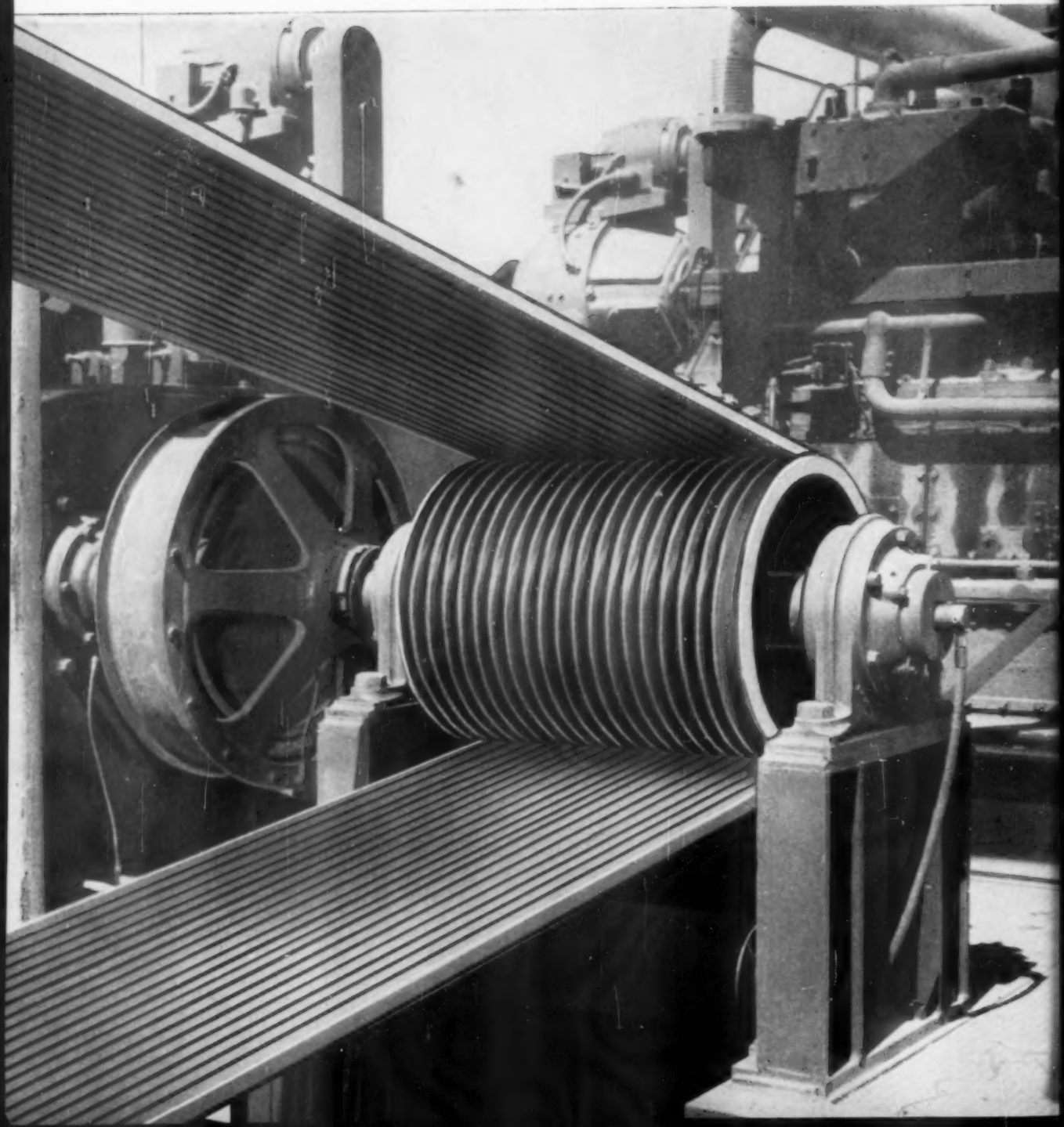
WHY MULTI-MATCHED MAKE YOUR MAINTENANCE DOLLAR



DAYTON V-BELTS GO FARTHER

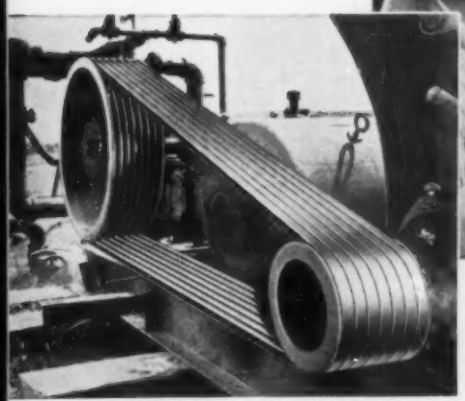
Precision matching assures long, uniform life for every V-Belt in a set

In transmitting power to mud pumps and draw works the service life of the *set* is the important thing. Premature failure of one or two V-Belts in a set is costly. And only when a set is accurately matched can it give the long trouble-free performance that makes your rig maintenance dollars cover more ground.

To be certain you get the longest possible service, Dayton *multi-matches* every set. Strict quality controls make every V-Belt as alike as possible in construction. Then they are matched in the factory on precision machines. Again and again at Regional and District Warehouses matching is checked and re-checked. Always the same type of precision equipment is used.

These matching machines, called Matchometers, are designed and built exclusively for Dayton. Their repeated use is your assurance that each Dayton V-Belt in a set will pull its share of the load.

Next time you order, remember *multi-matched* Dayton V-Belts. You can get them at over a hundred supply points.



Every set of Dayton Thorobred V-Belts is *Multi-Matched* on precision Matchometers, the finest device made for matching V-Belts, built exclusively for Dayton Rubber Company.

© D.R. 1957

World's Largest Manufacturer of V-Belts

Dayton Rubber

The Dayton Rubber Company, Industrial Replacement Div., Dayton 1, Ohio

Dayton V-Belts Available Through over a Hundred Oil Field Supply Points

DAYTON REGIONAL WAREHOUSES

Los Angeles, Calif.—909 East Slauson
Dallas, Texas—925 Slocum
Houston, Texas—1308 La Branch

DAYTON DISTRICT WAREHOUSES

California
Bakersfield—109 23rd St.
San Francisco—401 Howard St.

Louisiana
New Orleans—632 S. Peters St.
Shreveport—214 N. Market St.

Texas
Abilene—628-30 Walnut St.
Corpus Christi—1920 N. Port Ave.
El Paso—1701 Texas St.
Odessa—111 N. Lee St.
Pampa—159 S. Cuyler St.
Wichita Falls—1300 Indiana Ave.

Oklahoma
Tulsa—1124 East 4th St.

FIELD STORE STOCKS

Arkansas
All Republic Supply Stores

California
All Bethlehem Supply Stores
Bakersfield—Power Transmission and Equipment Co.
San Francisco—H. N. Cook Belting Co.

Colorado
All Republic Supply Stores

Illinois
All Republic Supply Stores

Kansas
All Republic Supply Stores
Coffeyville—Acme Foundry Co.

Louisiana
All Republic Supply Stores
Lake Charles—
Behring's Bearing Service of La., Inc.
New Orleans—
New Orleans Belting and Bearing Co.
Oil City—Oil City Hardware Co.
Shreveport—Bearing Transmission Co.

Nebraska
All Republic Supply Stores

New Mexico
All Republic Supply Stores

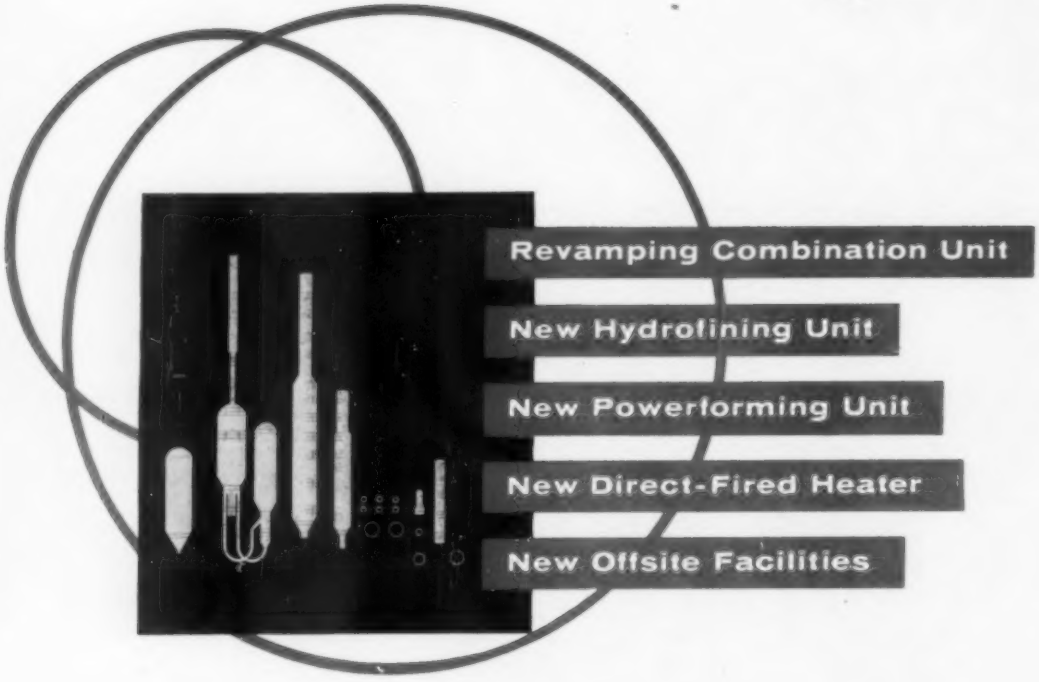
Oklahoma
All Republic Supply Stores
Oklahoma City—Green Head Service Co.
Tulsa—Engineering Supply Co.

Texas
All Republic Supply Stores
Abilene—Carpenter V-Belt Co.
Amarillo—Radcliff Supply Co.
Beaumont—Behring's, Inc.
Borger—Radcliff Supply Co.
Brownsville—Alamo Iron Works
Cisco—Walton Electric Co.
Corpus Christi—Alamo Iron Works
Bradley's Motor & Armature Works
Houston-Oil Field Material Co.
Stewart Dean Co.
El Paso—El Paso Saw & Belting Co.
Freer—Houston-Oil Field Material Co.
Houston—
Behring's Bearing Service Co.
Houston-Oil Field Material Co.
Kilgore—Jack Anderson Engine Co.
Lubbock—Lubbock Electric Co.
Bearing Specialists Co.
Lufkin—Lufkin Foundry & Machine Co.
Midland—Electric Motor Service Co.
Odessa—Duke Electric Co.
Pampa—Radcliff Supply Co.
Pearsall—Houston-Oil Field Material Co.
San Antonio—Alamo Iron Works
Wichita Falls—Mims Bearing Co.
Hornsby Heavy Hardware Co.

Wyoming
All Republic Supply Stores

expansion

at Durban



Foster Wheeler Corporation, builder of the original Durban refinery for Standard-Vacuum Refining Company of South Africa, Pty. Ltd., will design and construct all major process units for this expansion project. The new units and revamping of existing facilities will improve both quality and yield of the refinery's full range of fuel products and asphalts.

Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.

FOSTER WHEELER

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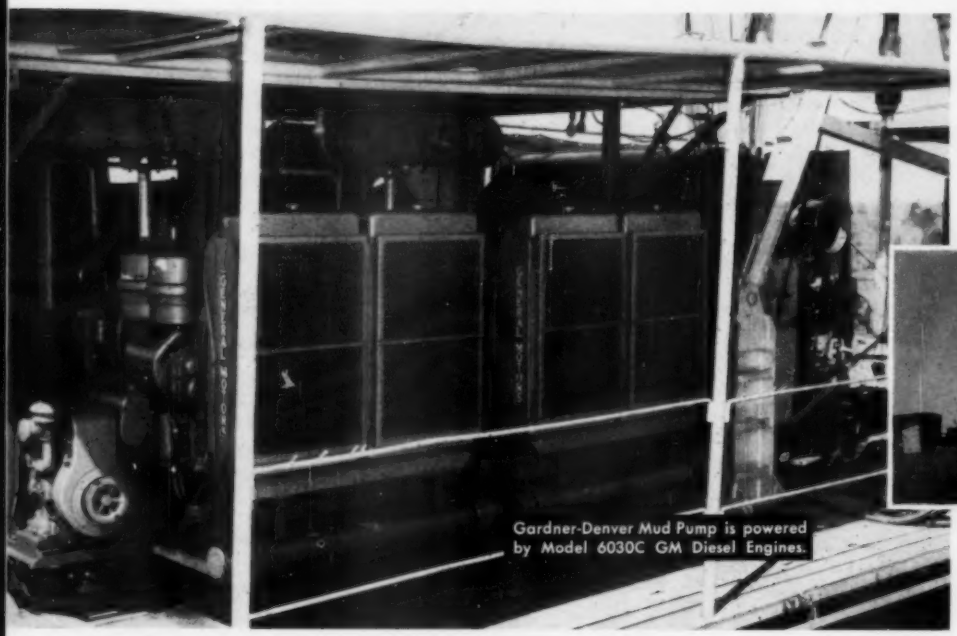
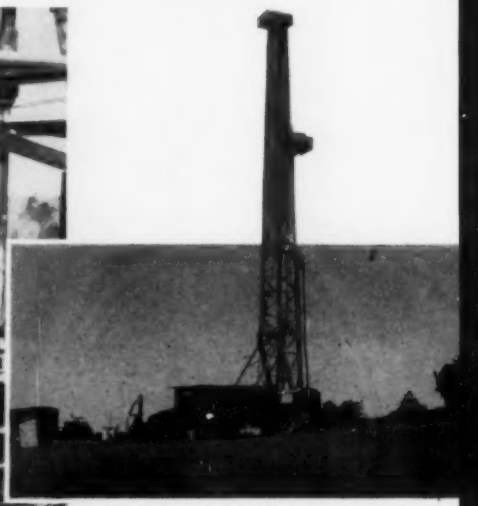
DEPENDABLE POWER



Gardner-Denver Mud Pump is powered by Model 6030C GM Diesel Engines.



South States Drilling Company's Rig No. 1 in the Longview area.

GM DIESEL ENGINES EASE THE WAY IN EAST TEXAS

In today's push for fast and economical drilling, Stewart & Stevenson GM Diesel Engines are proving their mettle to contractors, regardless of the type of rig or areas of operation.

Take East Texas, for example.

The South States Drilling Company of Longview, Texas, shifted to GM Diesel power through S. & S. — Industrial Power & Supply Co. The results are in the drilling logs.

Of the new power, Mr. B. J. Baird says —

"In regard to performance, we noticed a decided improvement in power and acceleration."

The Cardwell unit shown above is Rig No. 1, which is powered by two Model 12107 Stewart & Stevenson GM Diesel Engines. The 5 x 10 Gardner-Denver mud pump is driven by a Model 6030C GM Diesel Engine.

Stewart & Stevenson Services, Inc., assumed the leadership nation-wide in the sale of diesel engines because of the quality of both its product and service. A qualified Stewart & Stevenson parts and service man is always at your command, in the city or in the most remote areas.

A complete staff of engineers, modern shop facilities for designing and fabrication, solid experience all down the line — these are the distinguishing characteristics of the company that can sell you the best power at the best price.

STEWART & STEVENSON

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We're proud of our record in meeting every power need for the nation's leading drilling contractors

THE WORLD'S LARGEST DISTRIBUTOR OF DIESEL ENGINES

No embrittlement! Lowest cost! ASME Code approved!

In the subzero operating range . . . Specify Alcoa Aluminum equipment and piping

The flow chart details a tonnage oxygen plant now in actual operation where process temperatures average below minus 300° F. Notice that virtually all of the equipment and process piping are ALCOA® Aluminum. There's a good reason: aluminum is the lowest cost metal able to perform satisfactorily at low temperatures.

At subzero temperatures, ASME code approved aluminum alloys suitable for welded construction display improved yield and tensile strengths with no reduction in ductility or resistance to shock loading (see graphs). There is no embrittlement!

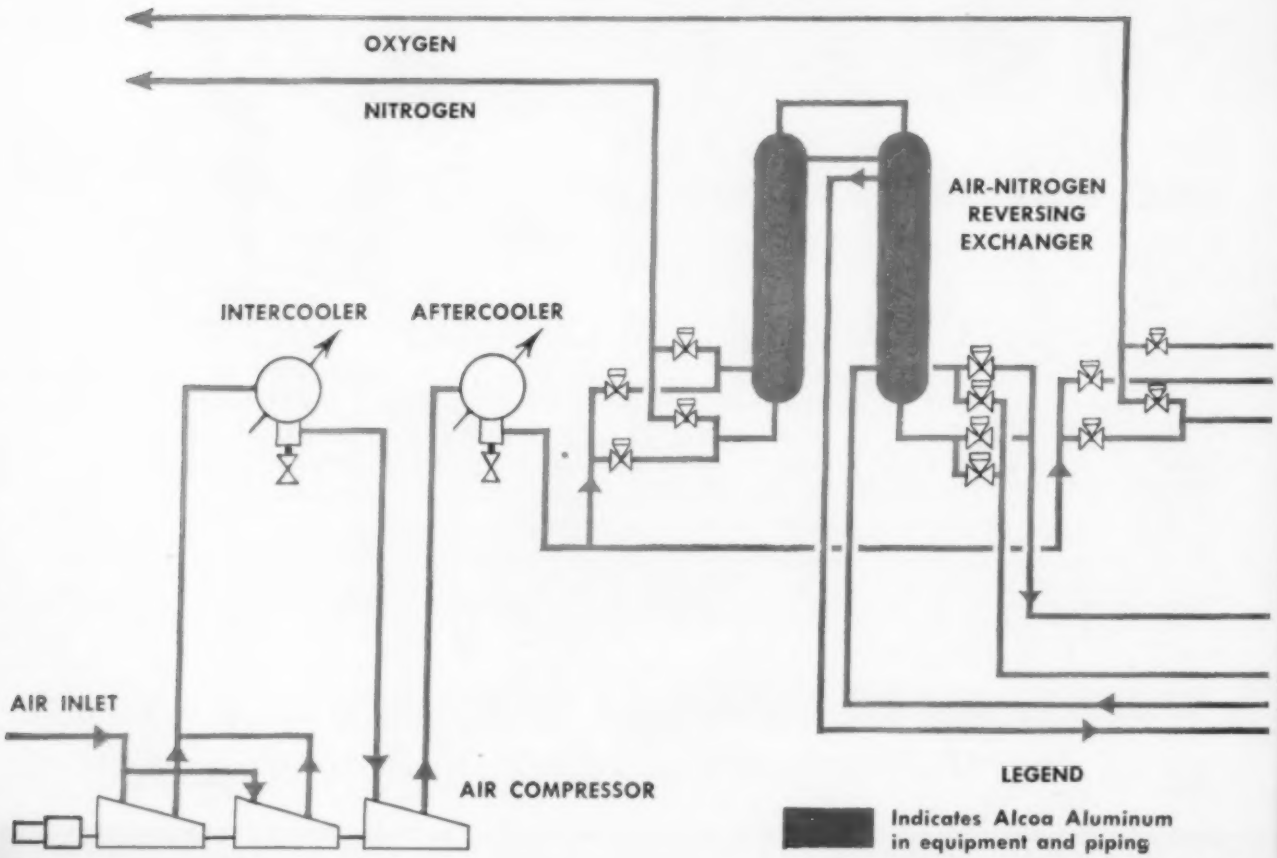
And in these operating temperature ranges, aluminum offers other valuable benefits . . . light weight . . . excellent resistance to corrosion . . . great strength in alloys . . . high thermal conductivity . . . nonmagnetic, nonsparking characteristics . . . nontoxicity . . . and excellent reflectivity. It is highly workable and lends itself readily to a variety of welding or brazing techniques for easy fabrication.

When *you* are looking for a low cost answer to the many problems of satisfactory equipment and piping performance in low temperature operations, *it will pay you to specify Alcoa Aluminum.* ALCOA engineers have worked with aluminum in the process industries for over 30 years. Use their accumulated knowledge to help you find satisfactory answers to *your* process equipment problems. Consult the nearby ALCOA sales office listed in the Yellow Pages of your telephone directory . . . or outline your equipment requirements in a letter to ALUMINUM COMPANY OF AMERICA, 904-G Alcoa Building, Pittsburgh 19, Pa.

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

ALCOA ALUMINUM

THIS FREE BOOK is filled with detailed data on the behavior of aluminum in the process industries . . . the result of more than 30 years of Alcoa engineering experience with aluminum in a variety of applications in nearly every temperature range. Use it as your guide to trouble-free, corrosion-free process equipment and piping. Write today for *Process Industries Applications of Alcoa Aluminum.*



LOW TEMPERATURE PROPERTIES OF ALCOA ALLOY 5154-0

Alcoa Aluminum actually increases in strength with no loss in ductility as temperatures drop to minus 320°F and below. Alloy 5154-0, for example, improves 50% in tensile strength, over 13% in yield strength and approximately 60% in elongation.

Photograph shows installation of Alcoa Aluminum equipment and piping in oxygen plant detailed in flow diagram. Harp-type heat exchangers (left) are dip-brazed assemblies with thousands of fins for best heat transfer.

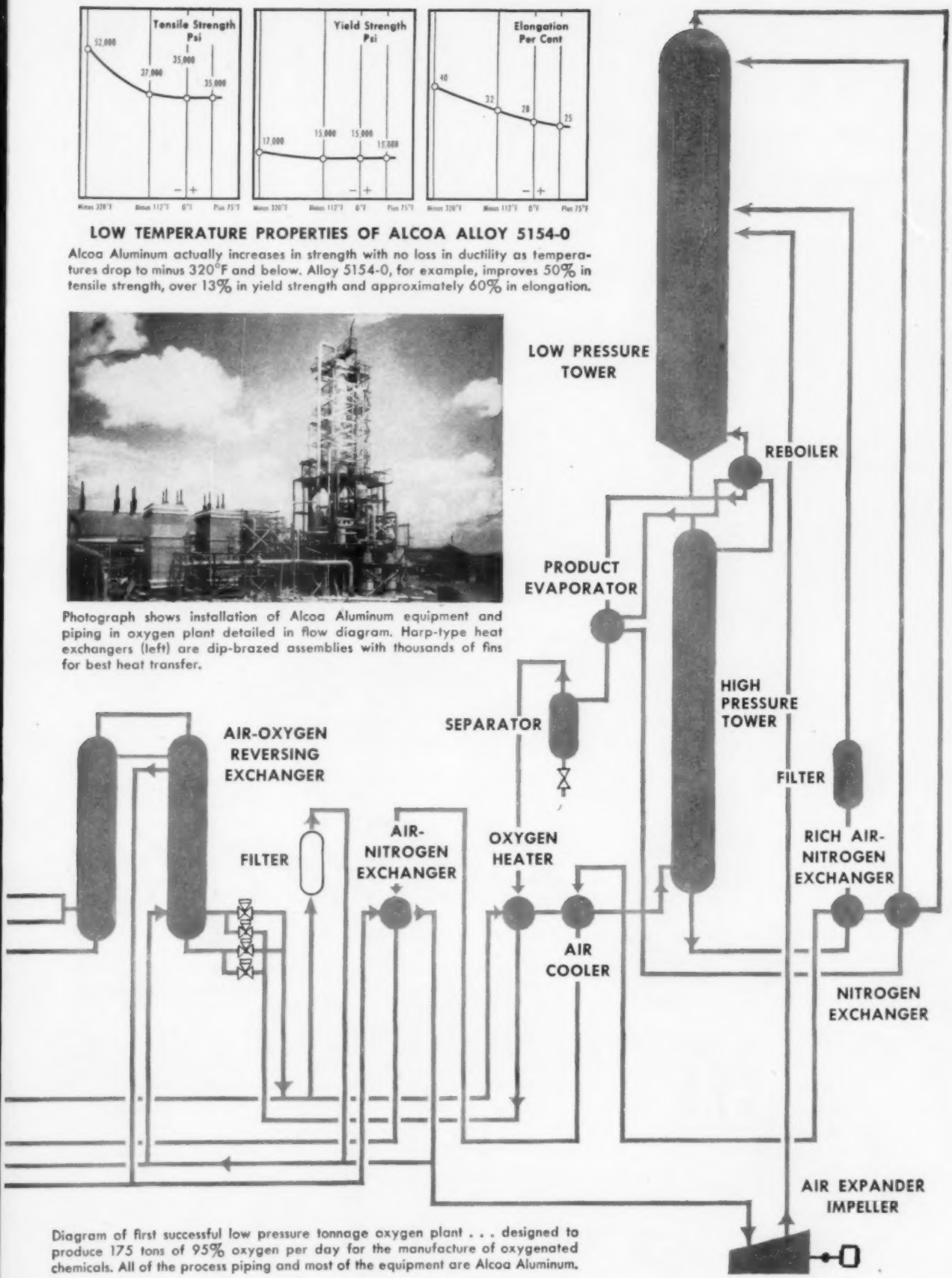


Diagram of first successful low pressure tonnage oxygen plant . . . designed to produce 175 tons of 95% oxygen per day for the manufacture of oxygenated chemicals. All of the process piping and most of the equipment are Alcoa Aluminum.

Ski lift operators stress safety when it comes to buying wire rope. Too many lives are at stake. So they buy . . .

A Safe Lift

Even though you don't operate a ski lift, false economy can be costly in your rope purchases, too. For a rope failure can cause personal injury . . . wreck your equipment . . . throw off your entire work schedule . . . and affect employee morale. Yes, a "bargain" wire rope may save you money, yet cost you your peace of mind. Don't take a chance. Buy a rope that's a quality rope—buy Wickwire Rope.

CF&I

WICKWIRE ROPE
A CF&I PRODUCT

LOOK FOR THE YELLOW TRIANGLE

PRODUCT OF WICKWIRE SPENCER STEEL DIVISION
THE COLORADO FUEL AND IRON CORPORATION

5050

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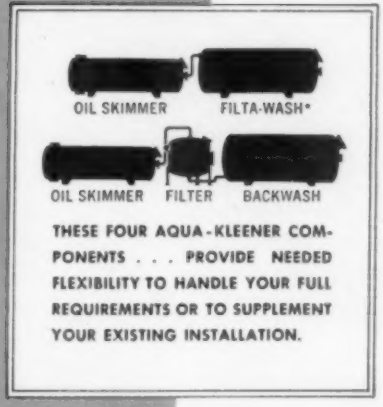
BS&B AQUA-Kleener* Systems

Extend The Service Life Of Water Injection Wells!



THESE FOUR AQUA-KLEENER COMPONENTS . . . PROVIDE NEEDED FLEXIBILITY TO HANDLE YOUR FULL REQUIREMENTS OR TO SUPPLEMENT YOUR EXISTING INSTALLATION.

The BS&B AQUA-KLEENER System was especially developed to meet the water conditioning requirements for water-flooding, sub-surface disposal of salt water and off-shore water disposal.

Numerous AQUA-KLEENER installations, similar to the one pictured above, are today greatly extending the service life of water injection wells by removing solids, oil traces and other contaminants before the water is pumped back underground. If this were not done, the underground formation pores would soon become clogged to the point where the injection well would cease to function.

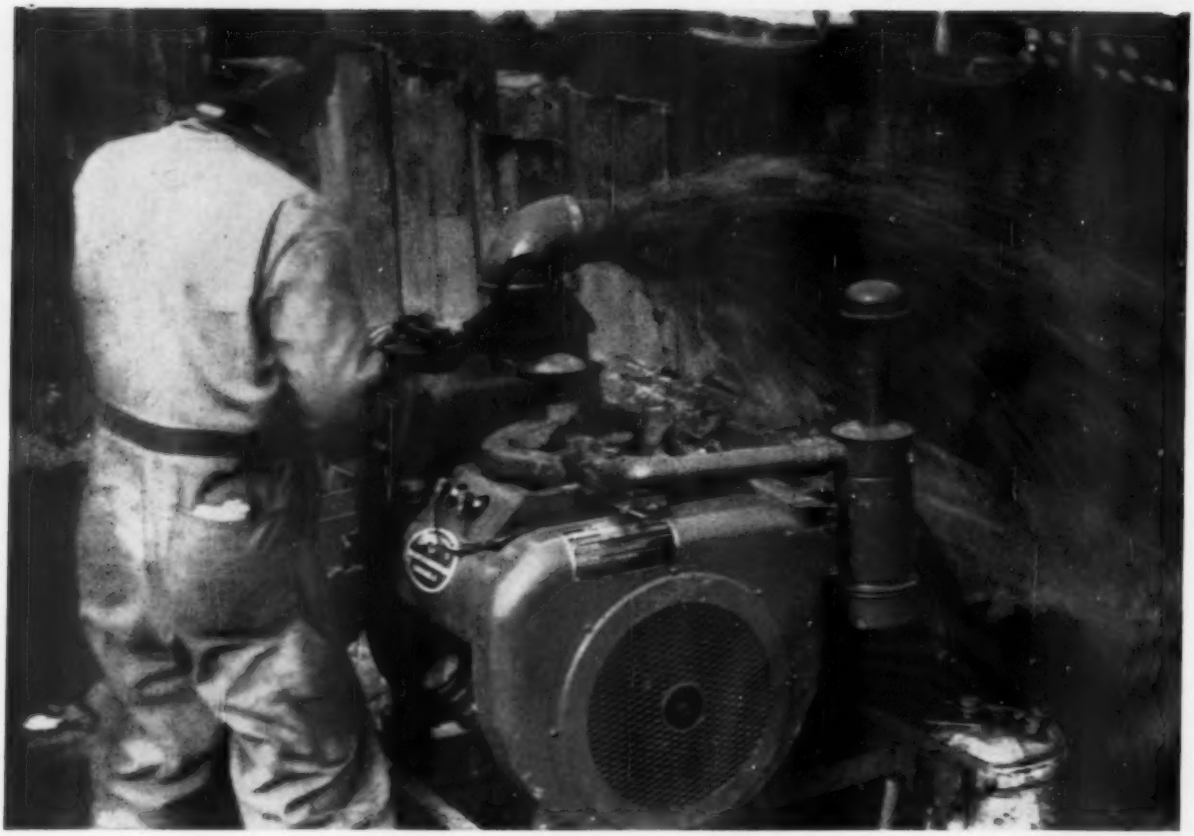
In addition to its primary function of removing solids and oil traces from lease-produced and surface waters, AQUA-KLEENER also performs the valuable secondary functions of reducing precipitation due to oxidation of iron, minimizing corrosion, holding carbon dioxide in solution, retarding aerobic bacteria growth, and in most cases, eliminating the need for chemical treatment of the water.

If you have a water injection or disposal problem, it will pay you to get full details on AQUA-KLEENER Systems from your BS&B Representative. Or you may write to . . .

* AQUA-KLEENER and FILTA-WASH are trade names of Black, Sivalls & Bryson, Inc.

EFFICIENCY
OVER 60 YEARS
BS&B
RELIABILITY
ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.
Oil & Gas Equipment Div., Dept. 1-A7
P. O. Box 1714
Oklahoma City, Oklahoma



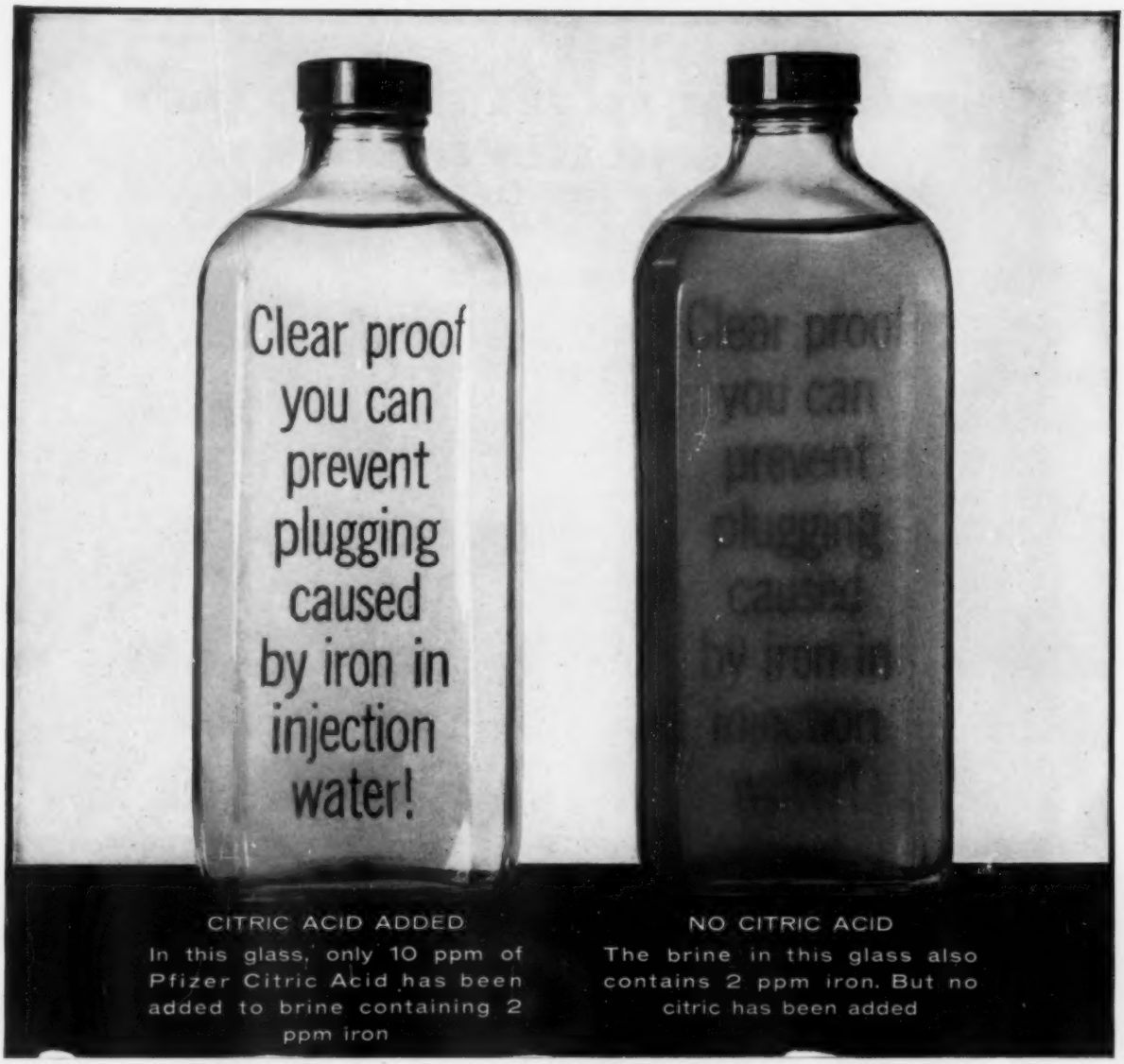
Gorman-Rupp Pumps keep this hot job moving!

The Horvitz Company, under a $2½ million contract, is building a ten-span bridge over the historic Ohio Canal and Cuyahoga River near Cleveland. The job, which includes two other bridges and river relocation, opens up a direct connection between heavily traveled Routes 8 and 21.

Constant seepage from the canal is always a threat for Mike Sekela, supervisor for Horvitz. Here he has spotted a Gorman-Rupp 40M Pump, Model 34A-VG4D, to dewater the cofferdam 20 ft. down for pilings. Mike says, "We prefer Gorman-Rupp because of their proven dependability."

THE GORMAN-RUPP COMPANY

305 Bowman Street • Mansfield, Ohio


Clear proof you can prevent plugging caused by iron in injection water!
CITRIC ACID ADDED
In this glass, only 10 ppm of Pfizer Citric Acid has been added to brine containing 2 ppm iron
NO CITRIC ACID
The brine in this glass also contains 2 ppm iron. But no citric has been added

● The cloudiness of the brine at right is caused by insoluble iron salts. Continuous injection of this water in secondary recovery causes plugging at the interface.

As you can see from the picture on the left above, Pfizer Citric Acid keeps the iron in your injection water from precipitating out... and thus piling up deposits at the interface.

Net result: Regular use of Pfizer Citric Acid will keep your injection rates high easily and economically. Also cuts down the frequency of expensive acidizing.

Pound for pound, citric acid sequesters iron better and at less cost than any other agent. High calcium and magnesium waters will not interfere with citric's iron-sequestering ability.

Nontoxic, safe to handle—Pfizer Citric Acid is excellent preventive medicine—whether for secondary recovery or pressure maintenance work. Pfizer supplies huge amounts of citric acid for a multitude of industrial uses throughout the world. This broad distribution pattern assures you of receiving all the citric you need without delay. (Just recently, Pfizer has opened a new warehouse in Dallas to serve the Southwest.)

For further information on preventing injection well plugging with Pfizer Citric Acid write to:

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Branch Offices: Chicago, Ill.; San Francisco, Calif.; Vernon, Calif.; Atlanta, Ga.; Dallas, Texas

HOW TO GET ACCURATE INFORMATION IN CONSOLIDATED FORMATIONS

The *New* Schlumberger Combination Induction-Electrical Log

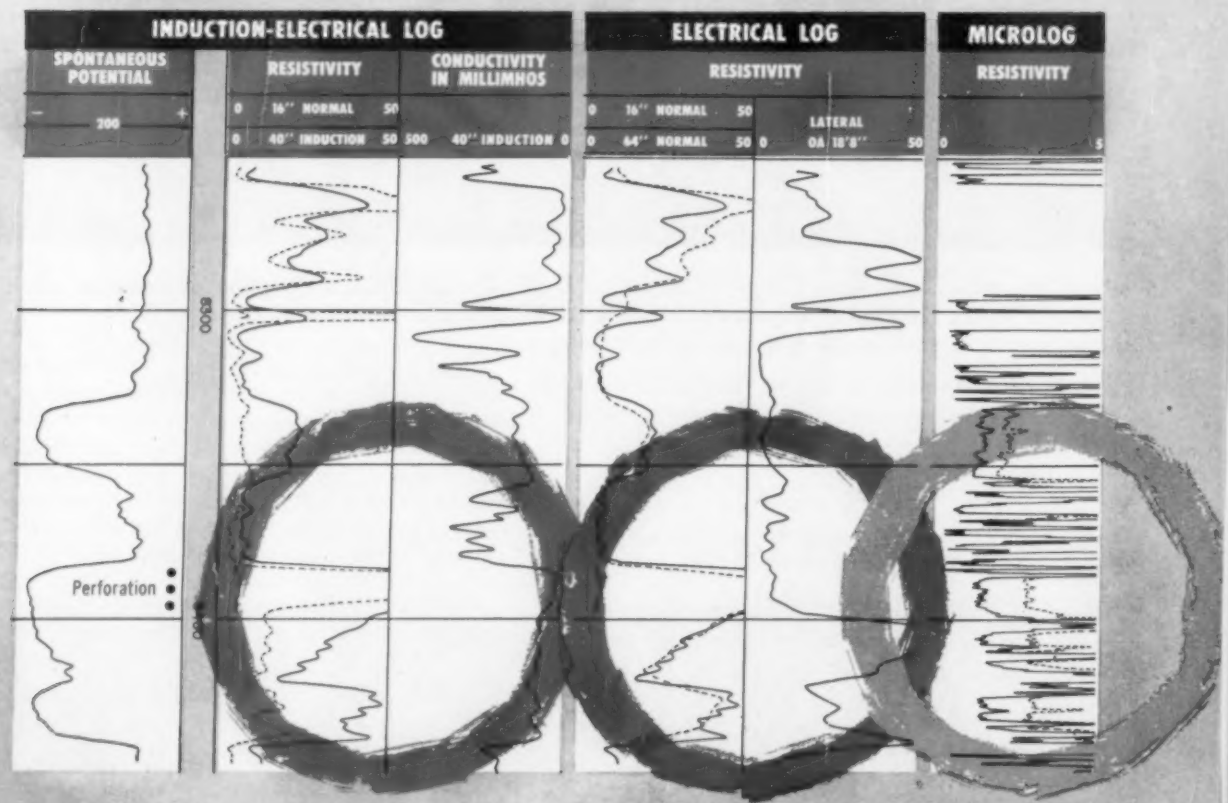
Sees More - Tells More

This example portrays the superiority of the Induction-Electrical Log in consolidated formations.

From top to bottom can be seen—sharp resolution in bed definition, penetration past the invaded section and curves with no distortion due to hard streaks or electrode spacings.

The producing section—is particularly outstanding because its limits are shown so clearly on the Induction Log while the electric log is difficult to interpret.

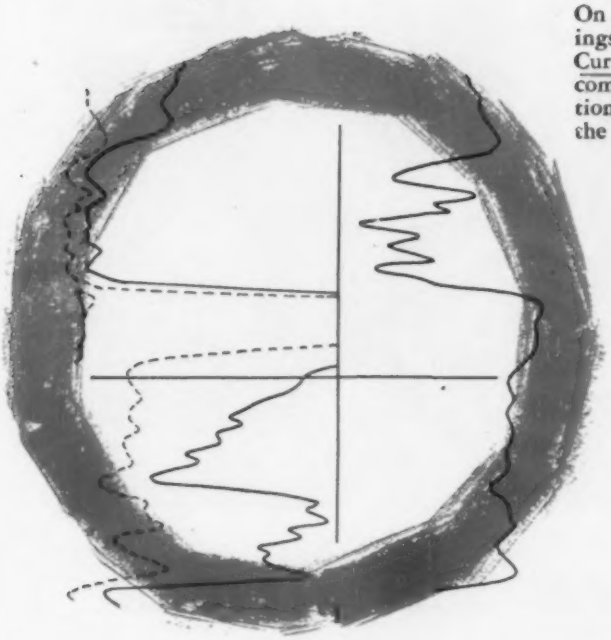
The perforated interval-produces 2.3 million cubic feet of gas per day with 20 bbls. of distillate per million.

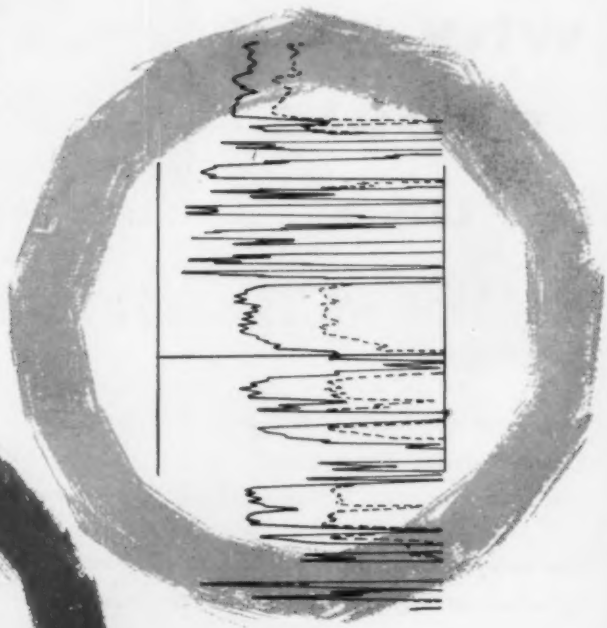


a major advance in well logging by Schlumberger

Formation evaluation

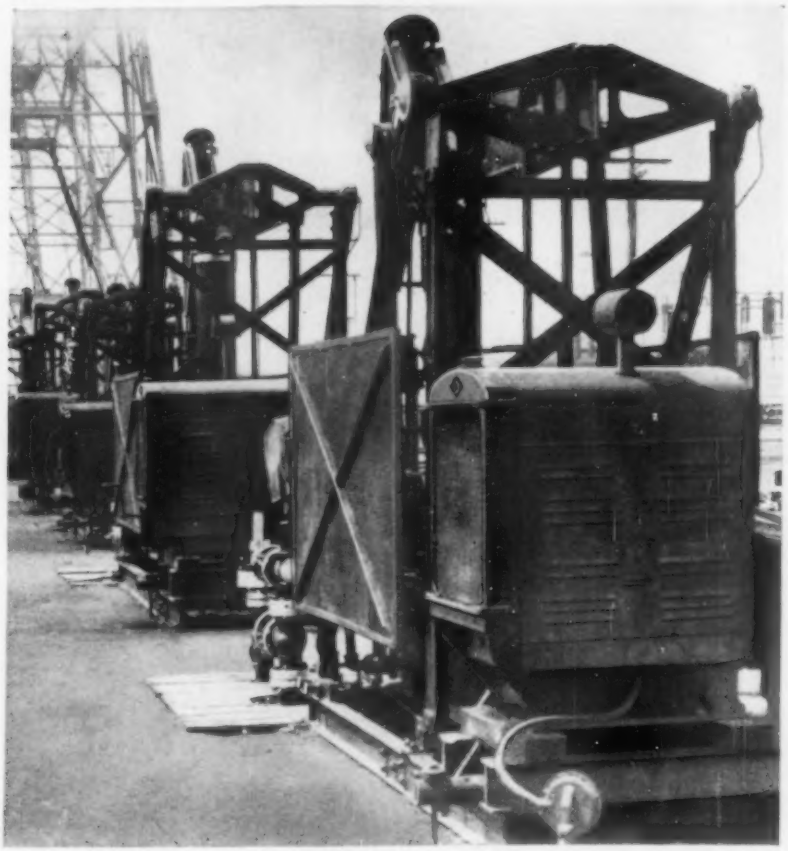
On the Electric Log, the sand is marked by high readings on the Short Normal, Long Normal and Lateral Curves. However, only the Induction-Short Normal combination clearly indicates the water-bearing section. The water level is well defined by the drop on the Induction Curve.





The high readings on the Short Normal and Long Normal Curves are the result of invasion. The lateral curve does not show the productive section at the top of the bed due to its characteristic lag. The lateral also gives high readings and misses the water in the lower section because of numerous hard streaks as shown by the MicroLog.

3 BIG reasons why you should use Allis-Chalmers Engines



They work day in, day out — season after season. Simplicity is a keynote of Allis-Chalmers design. For instance, one model has *30 to 50 percent fewer wearing parts than competitive engines!* Naturally, fewer parts mean less wear, less that can go wrong.

You enjoy 3-deep parts and service backing with practically "factory-town" service wherever you are! Allis-Chalmers' proven 3-deep dealer-branch-factory system means your dealer can obtain parts or factory-trained service help quickly from one of *18* strategically located factory branches.

There's an engine to EXACTLY fit your needs in the Allis-Chalmers complete line, 9 to 516 hp. Your choice of fuels, too — diesel, gasoline, natural or LP gas. See your Allis-Chalmers dealer, or write for complete information.

ALLIS-CHALMERS, BUDA DIVISION, MILWAUKEE 1, WISCONSIN

ALLIS-CHALMERS

BO-5

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Keeping gas dry is a "pipe" for Mathieson Diethylene Glycol. Its remarkable ability to absorb moisture makes it a leading agent for checking rust and corrosion in gas lines.

Meeting your most exacting requirements of quality and supply, Mathieson Diethylene Glycol is available in tank cars, tank trucks and resin-lined drums from our plant at Brandenburg, Ky., or from distribution points in key areas. Contact your Olin Mathieson representative today for full information.

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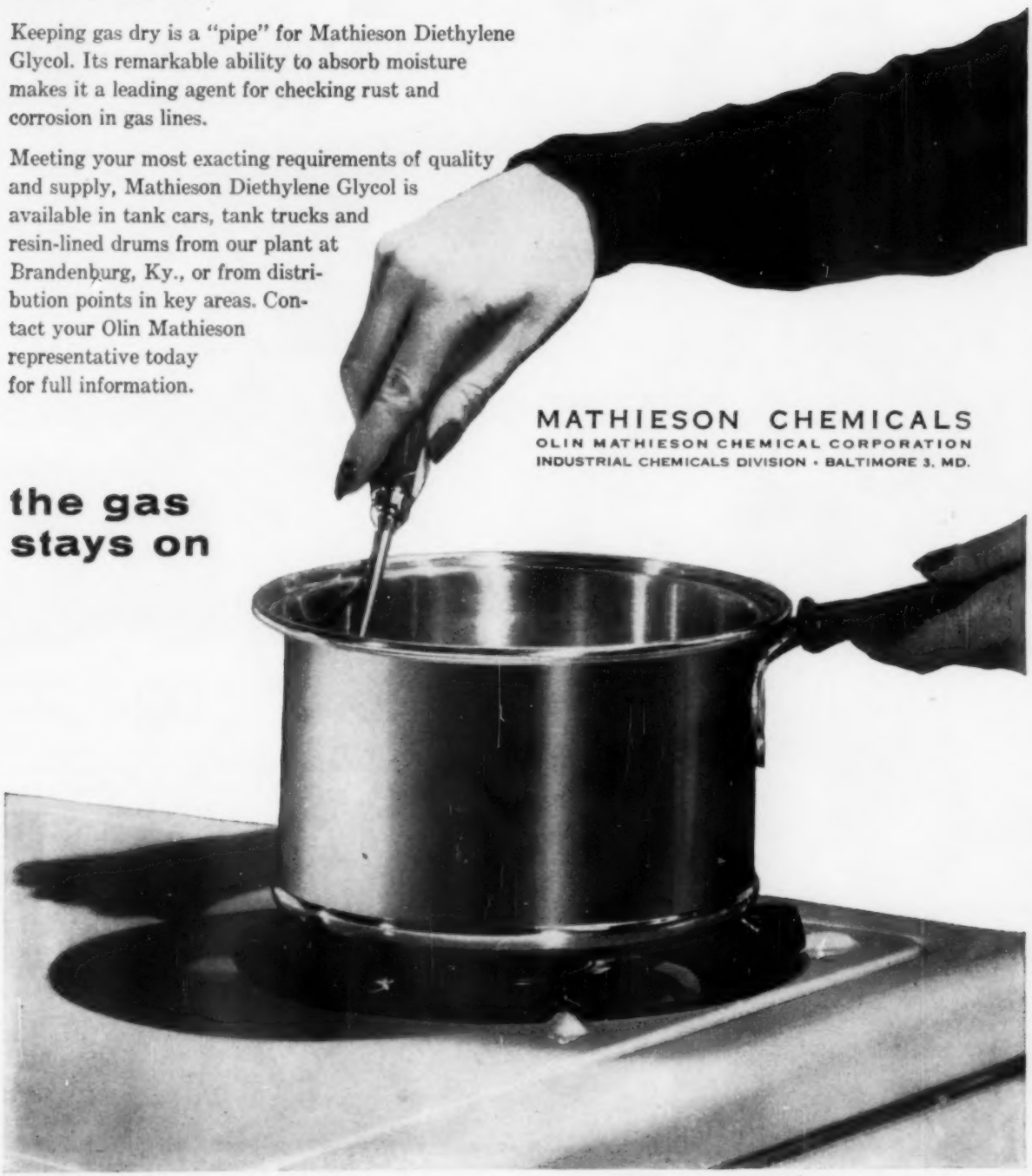
OLIN MATHIESON CHEMICAL CORPORATION
INDUSTRIAL CHEMICALS DIVISION · BALTIMORE 3, MD.

the gas stays on



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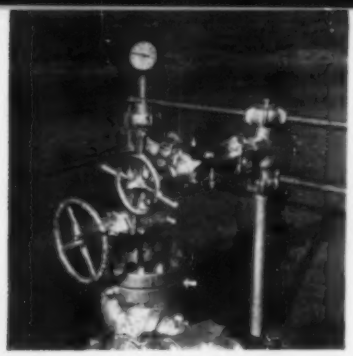
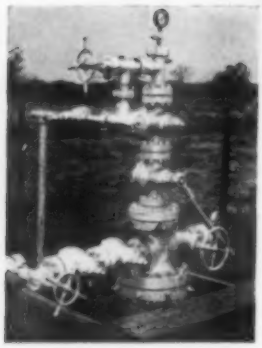
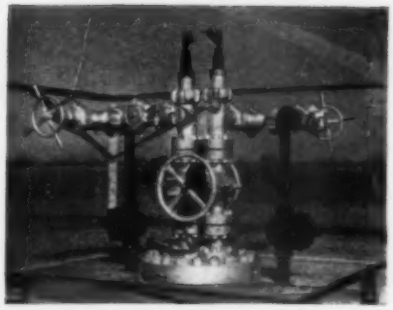
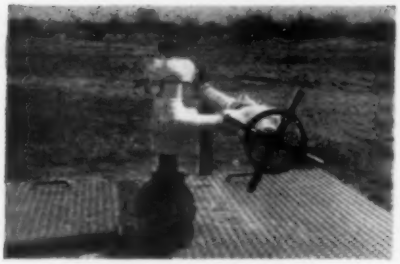
INORGANICS: Ammonia · Bicarbonate of Soda · Carbon Dioxide · Caustic Potash · Caustic Soda · Chlorine · Hydrazine and Derivatives · Hypochlorite Products · Muriatic Acid · Nitrate of Soda · Nitric Acid · Soda Ash · Sodium Chlorite Products · Sulfate of Alumina · Sulfur (Processed) · Sulfuric Acid

ORGANICS: Ethylene Oxide · Ethylene Glycols · Polyethylene Glycols · Glycol Ether Solvents · Ethylene Dichloride · Dichloroethylether · Formaldehyde · Methanol Sodium Methylate · Hexamine · Ethylene Diamine · Polyamines · Ethanolamines · Trichlorophenol · Surfactants









Nice thing about UNIBOLT Flow Manifolds . . .

you buy only what your well needs, and no more

Since well conditions and completion methods differ widely, no one Christmas tree flow control of the "fixed design" type can possibly serve all wells efficiently. Not so with UNIBOLT Flow Manifolds, the components of which may be readily arranged in any design to exactly fit well requirements.

These flexible Flow Manifolds, composed of standard UNIBOLT Tees, Crosses, Adjustable Wing Valves or Chokes, can be combined in a dozen different ways. Thus, you buy exactly what is needed for a given well.

And the entire manifold may be salvaged as a unit or in separate parts for later use in other manifolds.

From the lightest screwed manifold to the heaviest high-pressure assemblies and corrosion-resistant steel, UNIBOLT Flow Manifolds can be tailored to your needs. You save steel and, at the same time, you hold capital investment to a minimum.

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- **What tape to use for high, medium, low speeds, pressures and temperatures**
- **What tape to use for long or short wave length recording**

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INSTRUMENTATION DIVISION

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Send me the 3M Instrumentation booklet at once.

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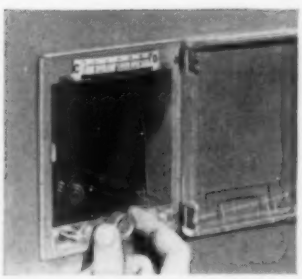
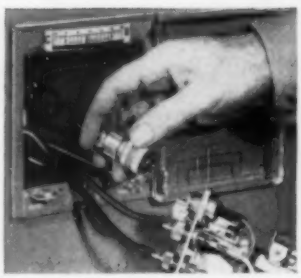
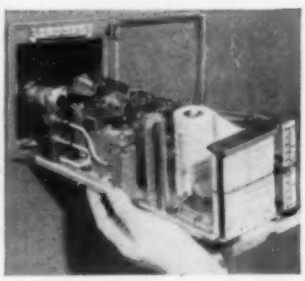


Shipment and installation of cases allows immediate completion of piping, checking of air lines and valve operation . . .



. . . Then you can install the recorder or indicator chassis, simply by reaching into case and attaching three finger-tight, self-sealing connections . . .



. . . Finally, slide the chassis into the case, and your process is on automatic control.

Immediate delivery of

TEL-O-SET*

cases

install them in your panel now–
insert TEL-O-SET instruments at startup

LET Honeywell *Tel-O-Set* recorders and indicators help you to start panel construction immediately. Here's how. Order the cases for the recorder and indicator now. Cases, available from stock, can be shipped separately to the panel manufacturer or to your plant site. Make complete piping connections, check air lines and valve operation . . . then install the chassis and controller later, at startup. They will always fit perfectly, because there are no plug-in projections or seal rings to be lost or damaged during shipment.

The indicator and recorder chassis don't have to be unpacked until you're ready for startup. That way, the instruments are fully protected against damage, and safeguarded from the dust and dirt that always accompany the final stages of plant construction.

Call your nearby Honeywell sales engineer for a discussion of this new shipping plan, and for more information about how *Tel-O-Set* instruments are easier to install, service, and operate. Or write for your copy of the new *Tel-O-Set* Catalog, No. C1001-1.

MINNEAPOLIS-HONEYWELL REGULATOR Co., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

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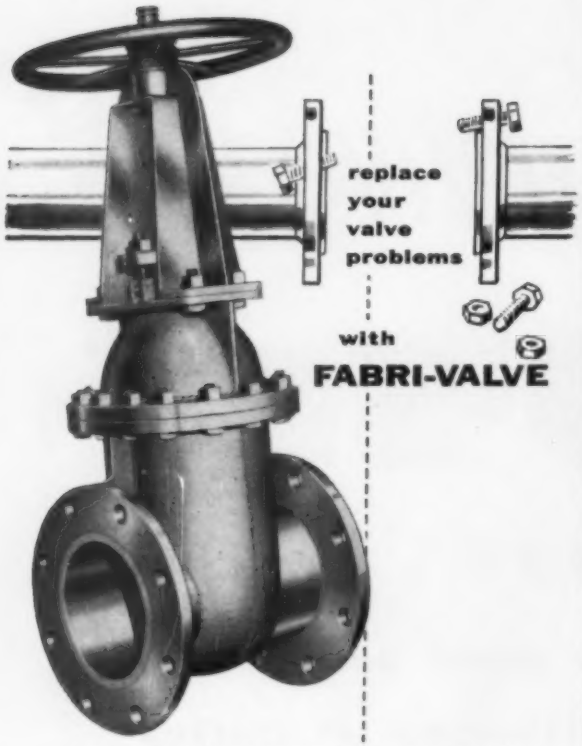

replace your valve problems with FABRI-VALVE

Fabri-Valve fabricates valves to meet specification for old or new. Whatever your need, new installation, modernization or replacement F-V can economically supply the answer to your valve problem. Custom-made or standard, F-V's are available in all sizes from 2" up in mild steel, stainless steel, nickel, or any workable combination to meet your specific problem. Contact your nearest distributor for complete details on how Fabri-Valves help solve your valve requirements.

CUSTOM-MADE to meet new plant specifications and existing installation problems for replacement and modernization.

STANDARD Fabri-Valves are kept in stock for economical replacement without costly loss of time.

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Shown F-V's 8" DiFAB, one of a line of modern valves for modern industry.

FABRI-VALVE DISTRIBUTORS: CORDES BROTHERS, Wilmington, Calif.; CORDES BROTHERS, San Francisco, Calif.; DIESEL ENGINEERING CO., Seattle, Wash.; FELKER BROTHERS, Marshfield, Wis.; THOS. W. MACKAY & SONS, LTD., Vancouver, B. C.; SOUTHERN CORPORATION, Charleston, S. C.

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You can talk the strange language of Oil with us because we "made up" some of the words! Fifteen of our directors are directly affiliated with the oil industry. We have one of the largest Oil Credit files in the nation; OIL LOAN service that includes oil-wise Trust Dept. counsel. See R. ELMO THOMPSON, R. OTIS McCLINTOCK, RUSSELL F. HUNT, WM. W. MICHAELS, BILL KENDALL or R. H. GWINNER. Remember, in Tulsa . . . in the Middle West . . . it's BOTH pleasant and profitable to . . .

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They Say—

Will Canada's policy change?

"Is it not time that the incentive to nonresidents to operate as foreign corporations rather than as subsidiary companies incorporated in Canada should be removed? The Conservative Party believes that it is long overdue.

"If foreign investments are to remain predominant in resource industries, Canada would tend to become a purely extractive national economy supplying the materials for other nations to process and turn into useful goods.

"We believe that the welfare of Canada demands the adoption of such a policy as will develop our national resources for the maximum benefit of all parts of Canada; will encourage more processing of Canada's resources in Canada; will foster wider financial participation by Canadians."

John Diefenbaker, Premier-Designate of Canada in a statement following the recent election.

Canadian natural gas

"Probably Canada's greatest need is for secondary industries to create employment and opportunities for its people. Natural gas will develop such industries primarily as a low cost flexible energy source but also from its many byproducts—chemicals, new processes, new products, liquid propane and all its uses, and the materials, products, and labor required for the construction of pipelines and distribution systems . . .

"Financially, the substantial savings by reducing imports from, and increasing exports to, the United States will help maintain the value of the Canadian dollar and the currency exchange rate. It will also help pay the dividends and bond interest required on the growing foreign investment in Canada."

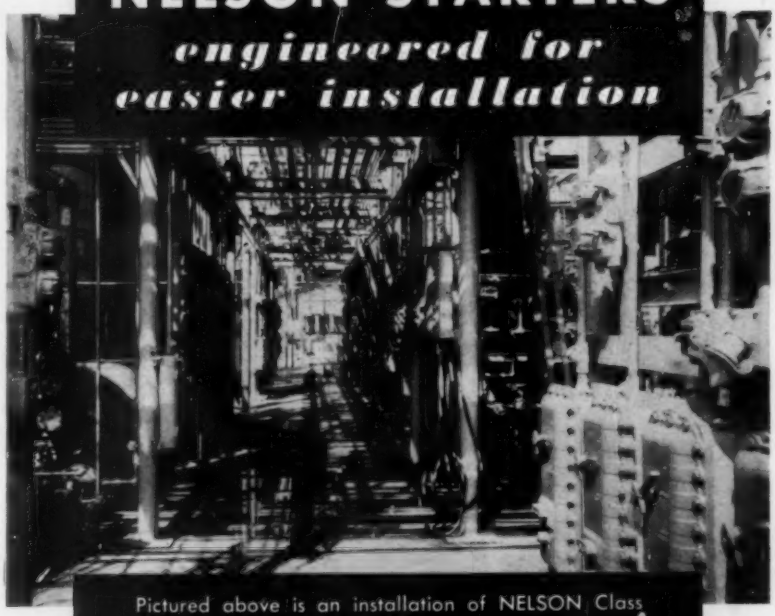
Herbert C. Darroch, president, Canadian Gas Association, in a speech at the association's annual meeting, Jasper, Alta.

The Canadian tax bite

"In addition to taxes charged against income, which last year amounted to $82 millions, the company acted, as a collector for road taxes and other direct levies totaling $95 millions.

"The total of all these taxes, $177 millions, was equivalent to 5 cents per imperial gallon on total sales volume, whereas net earnings from all sources, including oil production, refining, mar-

NELSON STARTERS
engineered for easier installation



Pictured above is an installation of NELSON Class 420 explosion-proof combination starters in the MARLEX* 50 Polyethylene Semi-Works Plant at the Phillips Chemical Company Research Center.

Nelson explosion-proof combination starters are shipped completely assembled, ready for installation, eliminating expensive field wiring. By removing four screws, all pan-mounted equipment can be removed leaving the entire enclosure clear for wire and cable pulling where desired. These features are a major factor in the growing demand for Nelson explosion-proof equipment.

These starters provide a convenient way to supply both automatic protection and control in Class 1, Group D, hazardous locations such as those found in refineries, petro-chemical plants, etc. More and more companies are recognizing the leadership of Nelson in manufacturing explosion-proof enclosures, and are specifying Nelson Starters when safety is of utmost importance.

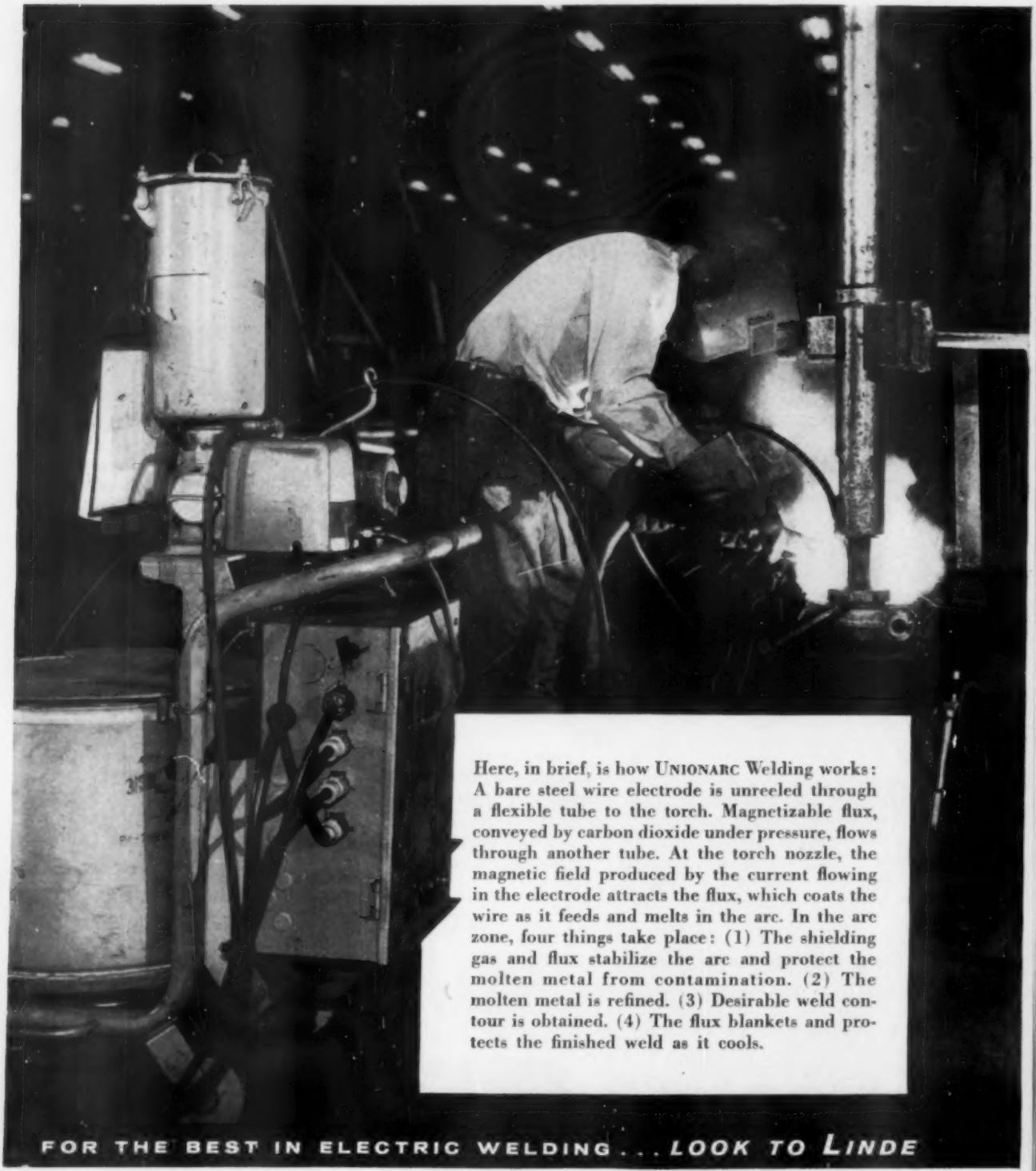
For more information on Nelson Combination Motor Starters, write for Bulletins 420 and 1026.

**MARLEX is a trademark for Phillips family of olefin polymers.*

a major source of electrical control equipment for industry

NELSON *Electric* MANUFACTURING CO.
TULSA, OKLAHOMA

Now... LINDE offers you another UNIONARC Magnetic



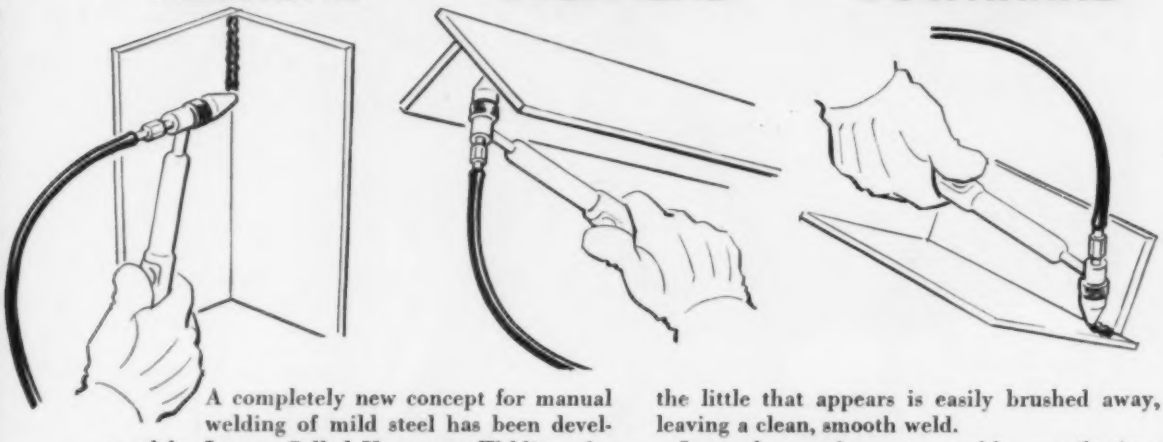
Here, in brief, is how UNIONARC Welding works: A bare steel wire electrode is unreeled through a flexible tube to the torch. Magnetizable flux, conveyed by carbon dioxide under pressure, flows through another tube. At the torch nozzle, the magnetic field produced by the current flowing in the electrode attracts the flux, which coats the wire as it feeds and melts in the arc. In the arc zone, four things take place: (1) The shielding gas and flux stabilize the arc and protect the molten metal from contamination. (2) The molten metal is refined. (3) Desirable weld contour is obtained. (4) The flux blankets and protects the finished weld as it cools.

FOR THE BEST IN ELECTRIC WELDING . . . *LOOK TO LINDE*

modern welding method— Flux Gas Shielded Arc Welding

UNIONARC *is an entirely new method of welding steel in all manual positions...*

VERTICAL **OVERHEAD** **DOWNHAND**



A completely new concept for manual welding of mild steel has been developed by LINDE. Called UNIONARC Welding, the method uses a continuously-fed bare steel wire electrode, which is magnetically coated with flux and shielded by carbon dioxide. The torch can be easily handled in all welding positions—vertical, overhead, downhand. Manual welds can be made at higher speeds and at lower cost than with covered electrodes. UNIONARC Welding produces high-quality welds in steel, even when moderate amounts of rust, scale, and moisture are present.

Among the numerous advantages of UNIONARC Welding are these: Rate of operation is up to three times faster than with covered electrodes. There is no stopping to renew electrodes, since a single loading of wire can be fed smoothly and continuously for periods up to a week. Manual skill needed is no more than that required with covered electrodes. In vertical and overhead positions, the deposition rate in UNIONARC Welding is two to three times greater than with covered electrode methods; in downhand positions, up to twice as great. There is practically no spatter—the little that appears is easily brushed away, leaving a clean, smooth weld.

LINDE has made many notable contributions to welding. Among these are the introduction and development of submerged arc welding (UNIONMELT Welding), non-consumable electrode, inert gas shielded arc welding (HELIARC Welding), and the development of Sigma (shielded inert gas metal arc) welding. LINDE's newest method, UNIONARC Welding, is another *first*—a truly important contribution. Its simplicity and versatility make it unique. Its efficiency and economy have been proved in actual production work. Write *now* for details about UNIONARC Welding, or call the LINDE office nearest you.

LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. Offices in other principal cities. *In Canada:* Linde Company, Division of Union Carbide Canada Limited.

The terms "LINDE," "HELIARC," "UNIONMELT," "UNIONARC," and "UNION CARBIDE" are trade marks of Union Carbide Corporation.

Linde
TRADE-MARK

UNION CARBIDE

Squeezing Burns Up Profits!

The Weatherford Technique helps you avoid squeeze jobs.

Everyone knows that squeeze cementing is costly—both in dollars spent and production time lost. The cost can never be recovered even if the squeeze is successful.

Squeezing can be avoided, however, by securing a good cement job the first time. The Weatherford Technique is the best known method of obtaining a good primary cement job. Considering the major investment required in drilling the well down to the casing point, The Weatherford Technique is mighty low cost insurance.

The Weatherford Technique helps prevent cement channeling and the formation of water voids, by controlling the excess water used in today's cement slurries.

It helps prevent bridging and so-called flash setting, by controlling the floculated mass of mixed mud and cement.

It helps insure a known annulus for the passage of mud and cement all around the casing, through the use of properly spaced centralizers of the correct size and type.

It helps insure a strong bond between cement and formation, by removal of excess wall cake, gelled or viscous mud, and other foreign matter.

Capable, experienced Weatherford engineers will plan your cement job in your best interest.

Take steps to insure a good primary cement job! Call the Weatherford office in your area, or write us for detailed information.

WEATHERFORD
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THE WEATHERFORD TECHNIQUE

keting, and transportation, equalled only 1.9 cents per imperial gallon.

"In the case of regular grade gasoline, the company received an average of 20.6 cents per imperial gallon on sales to retailers, while sales and road taxes averaged 13.1 cents—equivalent to 64 per cent of the company's price."

W. O. Twaits, executive vice president, Imperial Oil, Ltd., in a statement to shareholders.

Oklahoma's oil future

"From all we can determine, interest in Oklahoma oil development has seldom been higher than it is right now . . . Approximately 45 per cent of the total acreage of the state—some 18,000,000 acres—was under lease at the close of last year. Lease activity continues in several promising areas of the state right now. All indications are that this total figure of 18 million will move upward.

"Then, too, while Oklahoma holds fourth place among the states in terms of production, it currently ranks third in the percentage of successful wildcat completions. Seventeen per cent of the wildcats in Oklahoma found oil last year as compared with 13 per cent in Texas, 12 per cent in Kansas, and 6 per cent in Wyoming. Incidentally, Louisiana and New Mexico are the leaders in this category with 21 and 20 per cent, respectively."

George W. Clarke, vice president, Pan American Petroleum Corp., in a statement in "Horizons," company magazine.

Tidewater's view on imports

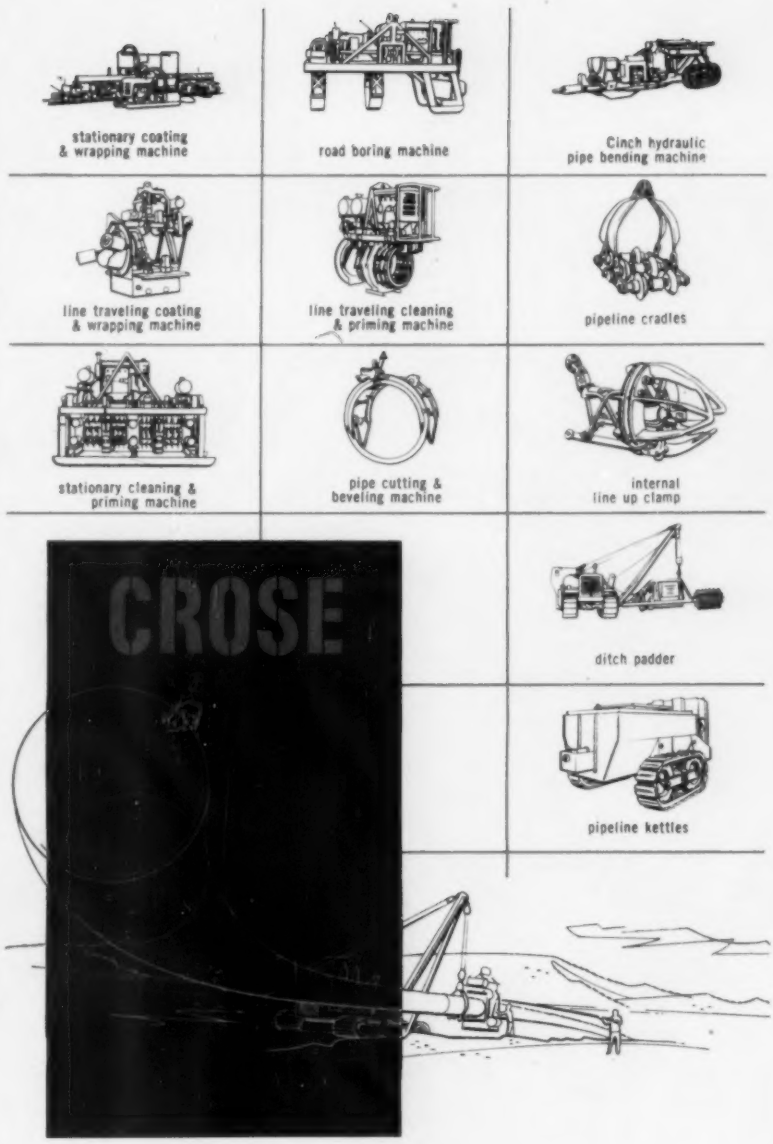
" . . . We believe . . . that the facts will show that any restriction on importation of foreign oil into the United States will be harmful to the American consumer and to our national security."

D. T. Staples, president, Tidewater Oil Co., in a letter to Gordon Gray, Office of Defense Mobilization director.

Imports watched in Oklahoma

"As the governor of one of the major oil-producing states of the nation, I am making it a part of my business to study all phases of this foreign import problem and its effect upon our oil production in Oklahoma.

"If any further reductions in allowables are asked in the State of Oklahoma while imports are still on the increase and the domestic consumption is holding its own or showing an increase, I am going to view it with a greater interest than I have in the past



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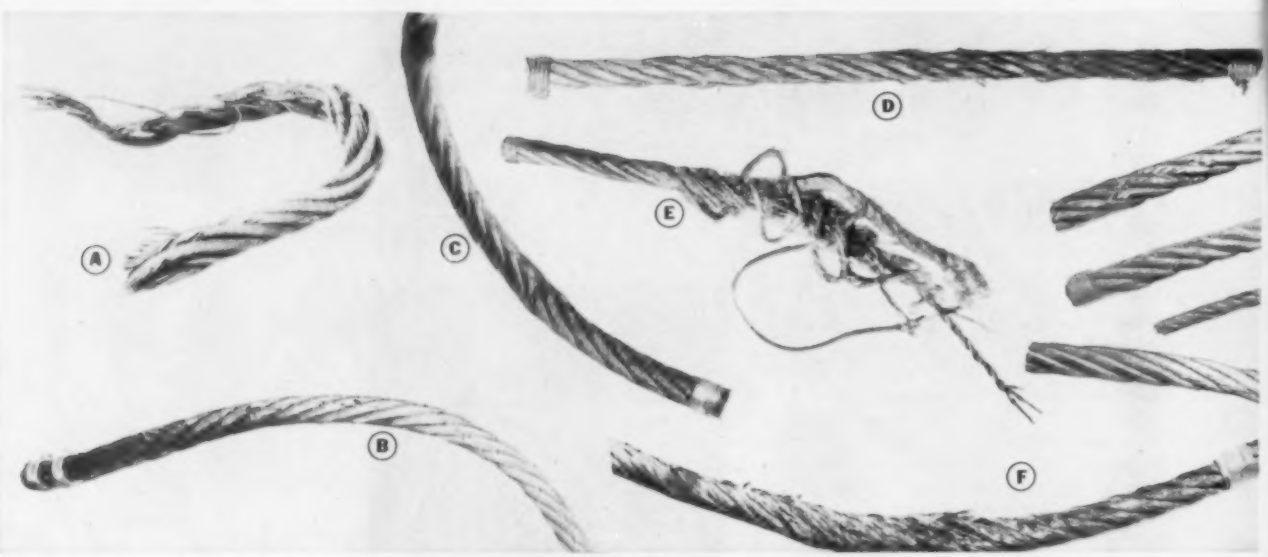
Tuffy Wire Rope Tips



Tuffy gives you a quick run-down here on some of the mortal enemies of wire rope — the abuses that quickly ruin rope efficiency or end its life abruptly long before you have had the service you paid for.

Even the best wire rope is a sitting duck for the enemies which won against the wire rope pictured on these pages. When you avoid or eliminate them you make important gains in longer rope life, better service and greater economy. Remember, your Tuffy distributor will be glad to work with you against these and other wire rope hazards.

It's the "end of the line" for wire rope when these things happen:

A. Mangled in a wedge socket. Here's the result of improper socketing. This fatal rope injury was caused by a poorly designed or worn out wedge socket. Failure at the dead end can damage other sections of the rope.

B. Rusty road to ruin. Rust — No. 1 enemy of steel — takes a heavy toll in wire rope life. It's an insidious, silent type of killer, often doing irreparable damage before it's even noticed. The one-strand break shown above resulted when the rope was allowed to become rust-bound through lack of lubrication. With other conditions ideal, tests show properly lubricated rope has up to 10 times the life expectancy of dry rope.

C. The crushing blow. The Sunday punch for this piece of wire rope was delivered by a tractor cleat — just one of many crushing injuries that result when wire rope is run over or banged into by a hard, sharp object. Even the best rope is no match for this kind of mistreatment.

D. Strangled by misfit sheaves. When the bearing surface of a

Tuffy Special Wire Ropes are tailored to special use. Ordering is easy:

Tuffy Rotary Lines

← Standard . . .
For drilling use with standard rigs in any formation. Also for deep drilling beyond 6000 ft. with jackknife rigs. Smooth spooling. Gives you more ton miles before cutting is necessary.

Or Jackknife →
Combines extra strength with extra flexibility. Spools easily on small sheaves and drums of jackknife rigs drilling to 6000 feet. Famous throughout the oil world as a topflight performer on all types of rigs.

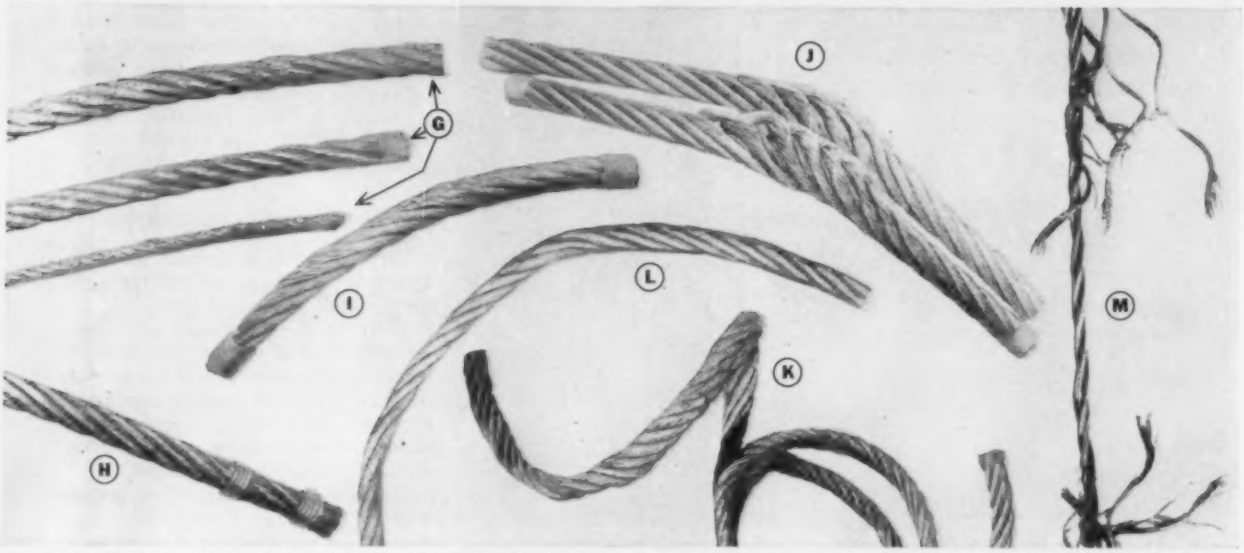
Ton-Mile Indicator and Log Book: Here's a slide-chart system of figuring ton-miles quickly and easily. Plus a log book in which to keep your ton-mile record.

Cut-Off Practice Book: Gives you the quick, easy method of telling when to cut-off and how much. Shows you how to obtain maximum service from rotary lines, how to avoid cutting too much, too soon, or too little too late. Includes cut-off tables for derricks of all heights with various draw-works.

Handbook of Wire Rope for well drilling and servicing. Packed with useful information on wire rope for rotary cable tool drilling and well servicing. Includes sizes and constructions of wire rope for all oil field services. Valuable tips on care of wire rope; handling, lubrication, seizing and socketing, and many other subjects.

FREE Write today for the books you want

How wire rope is crippled and killed without a fighting chance



sheave is too small for the rope diameter, pinching action quickly destroys the rope especially when it is overloaded. The one shown above was knocked out in just 1½ hours of service.

E. Apparent suicide! This rope jumped out of sheave and was soon destroyed by pulling around the shaft. Actually it was a case of sudden slack which threw the rope out of the sheave.

F. This rope came to an untimely end by operating over a sheave that did not turn. Note the exceptionally heavy abrasion on one side of the rope.

G. Victim of "the bends." Excessive bending soon wears out rope. Generally, more flexible ropes are used as bending stresses increase (with decrease in tread diameter of sheave or drum). If a rope is operated on a sheave too small for its bending characteristics, early failure is certain. Through an exhaustive series of bending tests, Union engineers have compiled data that you can use to be sure you get the rope construction that will give you the longest service life. Ask about it.

H. On the "blink" from a kink. This open kink resulted from mishandling of wire rope. Guard against kinks by proper winding on the drum. Never pull a loop smaller; always enlarge it, then straighten out the rope.

Crushed and worn from "beatings on the drum." Drum wear gives wire rope severe punishment even under normal operating conditions. This wear is found at the cross-over points and at the flange. Excessive drum crushing results from operating on too large or too small a drum. Here are typical "drum beatings":

I. Cross-over wear

J. Cross-over crushing on drum

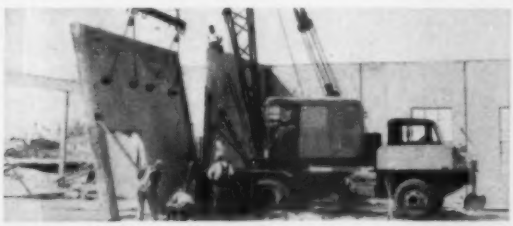
K. Drum-crushing on oversized drum

L. Drum-crushing on undersized drum

Although drum wear cannot be eliminated, its effects can be greatly reduced. Under properly engineered procedures, two and three times the service can be obtained from the same line. Union Wire Rope engineers will help you with this problem. Get in touch with us for more information.

M. Overloaded — soon exploded. Wire rope is "prescribed" for a given use on the basis of breaking strength plus a safety factor of 4. The grade of steel, type of construction and size of the rope determine tensile strength. It must be properly related to the loads it will carry, or expensive and dangerous early failures are likely to occur.

Just say **Tuffy** give length and size, and forget complicated specifications.



Tuffy Slings and Hoist Lines

Here's a team famous for cutting hoisting and downtime costs in all types of materials handling.

Tuffy Hoist Line is a longer running rope on all types of hoists. Tuffy Slings are made of a 9-part machine-braided fabric that stays extra flexible, and can't be hurt seriously by knotting or kinking.

Your Tuffy distributor will help check your equipment

Condition of equipment is a big factor in longer rope life and greater economy. Your Tuffy distributor will help you check equipment and operating conditions to make sure everything is in your favor for getting the greatest service out of your Union wire rope. Ask him to lend a hand in a thorough inspection. He'll be glad to do it. And if there are still knotty problems, Union Wire Rope Corporation engineering department will help further.

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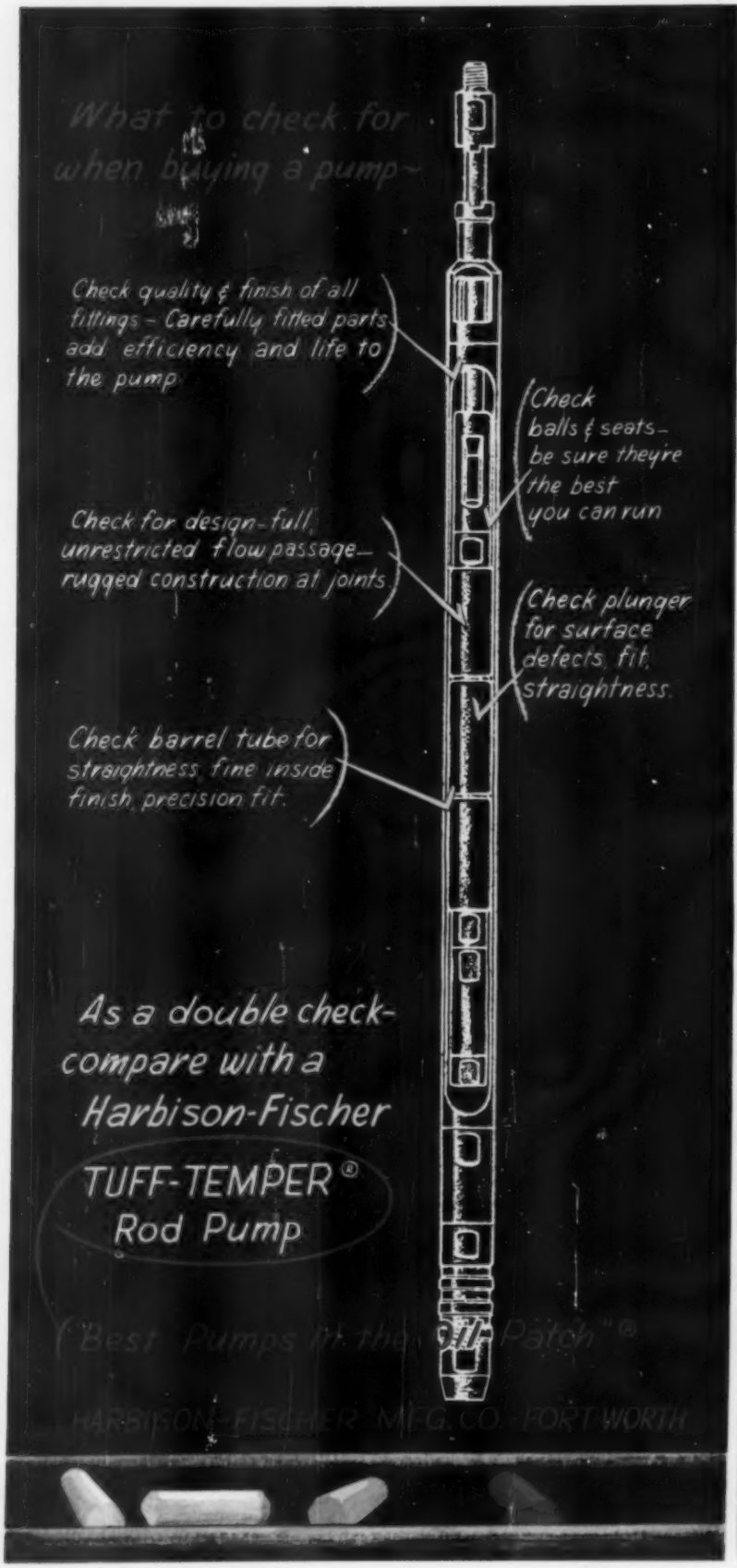
2

Specialists in high carbon wire, wire rope, braided wire fabric, stress relieved wire and strand


What to check for when buying a pump—
Check quality & finish of all fittings – Carefully fitted parts add efficiency and life to the pump
Check for design—full, unrestricted flow passage—rugged construction at joints
Check barrel tube for straightness, fine inside finish, precision fit.
Check balls & seats—be sure they're the best you can run
Check plunger for surface defects, fit, straightness.
As a double check—compare with a Harbison-Fischer
TUFF-TEMPER® Rod Pump
("Best Pumps in the Oil Patch")®
HARBISON-FISCHER MFG. CO. FORT WORTH

and shall consider taking some action that will bring relief to the State of Oklahoma."

Raymond Gary, Governor of Oklahoma, in a speech before the Interstate Oil Compact Commission.

Exploration concern mounts

"As far as this country is concerned, if we are to remain reasonably self-sufficient as far as petroleum is concerned, our oil-finding effort during the coming years will have to be more vigorous and enterprising and skilled than it has ever been before."

Morgan J. Davis, president, Humble Oil & Refining Co., in a speech to Gulf Coast petroleum writers.

Business world in politics

"The time is long past when industry could devote the training of its management personnel solely to the business at hand without relation to government. It seems inconceivable that a decade or so ago it was not uncommon for old-line companies to prohibit or frown upon employe participation or expression of views with regard to politics or government.

"Whether we like it or not government policies and laws indirectly or directly color and influence every major business decision. The man of business who tries to fulfill his duties without knowledge or advice of current developments in government soon finds that he is operating in a vacuum. A realization of this by management, and employes who aspire to management, should bring the further realization that active participation in the formulation of government policies is part of the responsibility of management."

John A. Ferguson, executive director, Independent Natural Gas Association of America, in a speech before the Texas A.&I. management conference, Kingsville, Tex.

CALENDAR OF EVENTS

JULY

8-19 Industrial Statistics for the Process Industries, second annual conference, sponsored by American Society for Quality Control and the University of Oklahoma, Lockett Hotel, Norman, Okla.

AUGUST

1-3 Rocky Mountain Mineral Law Foundation, third annual institute, Montana State University, Missoula, Mont.

19-20 North Dakota Oil and Gas Association, annual meeting, Bismarck, N. D.

26-28 Seventeenth annual Appalachian Gas

HELPFUL ANSWERS TO CAUSTIC QUESTIONS

As a leading supplier of Caustic Soda, Columbia-Southern is asked many questions each month about this versatile "workhorse" alkali. While the answers probably are not completely new to every Caustic user, they do re-emphasize certain basic points that shouldn't be forgotten. We hope that you will find this series interesting and helpfully informative.

At what concentration is liquid Caustic Soda normally stored?

It is normally stored at a concentration of 50%, although during winter months provision must be made to maintain temperatures above 60°F. It is general practice to dilute shipments of 73% liquid Caustic Soda to 50% concentration for storage. To store at 73%, heated tanks with special linings are required.

How much Caustic Soda is produced along with Chlorine in the Electrolytic process?

For each pound of chlorine, approximately 1.1 pounds of Caustic Soda are produced.

How is solid and flake Caustic formed?

To obtain the anhydrous forms of Caustic Soda, 73% liquor is boiled in large cast iron "fusion pots," driving off the water and leaving Caustic in a molten state. For solid Caustic Soda, the melted Caustic is poured into steel drums and allowed to harden. Flake Caustic Soda is produced by freezing the melted Caustic on a water-cooled rotary drum called a "flaker," after which it is sized by screening and packed in metal drums for shipment.

What is the best way to dissolve solid Caustic Soda?

There are two prescribed methods. (1) Split the drum at the seam with a crowbar and remove the metal from around the solid Caustic cake. Roll the exposed cake into a dissolving tank that is depressed below floor level. (2) Perforate the drum with a pointed tool or axe. Hoist the drum into an elevated dissolving tank. For either method, do not add water until after the Caustic or drums have been placed in the tank.

What are some of the typical savings of customers who have changed from buying 50% to 73% Caustic liquor?

One user invested $2,120 in equipment needed to unload and dilute 73% liquor to 50% and saved $20,979 in five years. Another user saved $2,850 in the first year on an investment of $2,650—or a return of 108%. A third one—a very large user—had a 1003% return the first year on an investment of $3,500—or a total of $35,000.

How much is tank car handling reduced by purchasing 73% vs. 50% liquor?

Forty percent fewer cars need to be handled for the same tonnage. For example, a customer using 2,000 tons of Caustic, solid basis, would require the following shipments:

73% liquid	*Tons per car*	*No. cars*
8,000 gallon cars	42	47
10,000 gallon cars	53	38
50% liquid		
	Tons per car	*No. cars*
8,000 gallon cars	26	77
10,000 gallon cars	32	62

If you would like amplification of any of the answers on this page, or of any other answers previously presented, you are invited to write our Technical Service Department at no obligation to you whatsoever.

Did you know that you handle 40% fewer cars when you buy 73% Caustic liquor rather than 50%, to obtain the same Caustic content?

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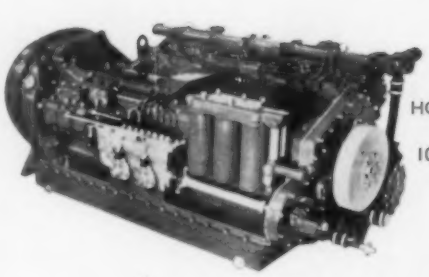
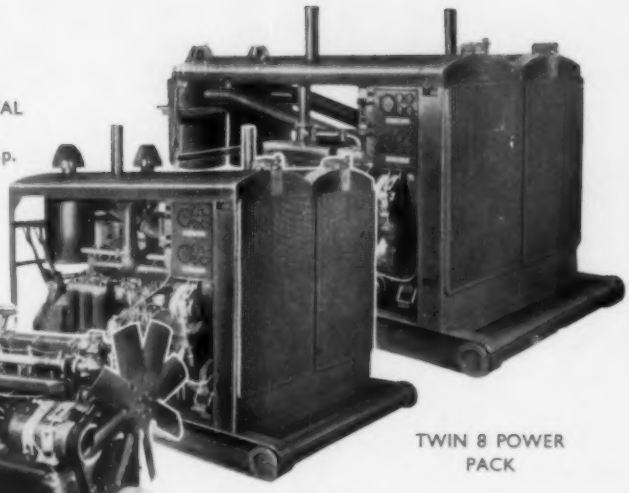
IN CANADA: Standard Chemical Limited and its Commercial Chemicals Division

ROLLS-ROYCE

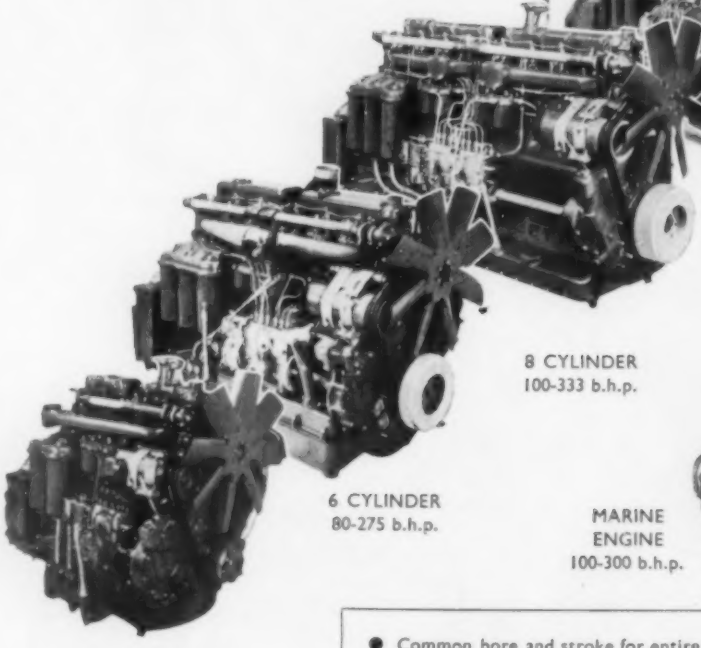
OIL ENGINES



HORIZONTAL ENGINE
100-300 b.h.p.



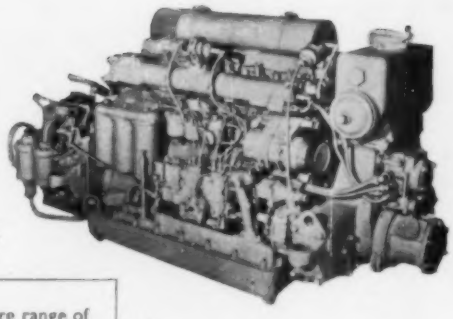
TWIN 8 POWER PACK



TWIN 6 POWER PACK

8 CYLINDER
100-333 b.h.p.

6 CYLINDER
80-275 b.h.p.



MARINE ENGINE
100-300 b.h.p.

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60-167 b.h.p.

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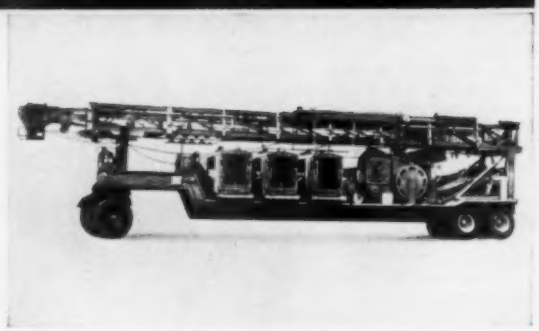
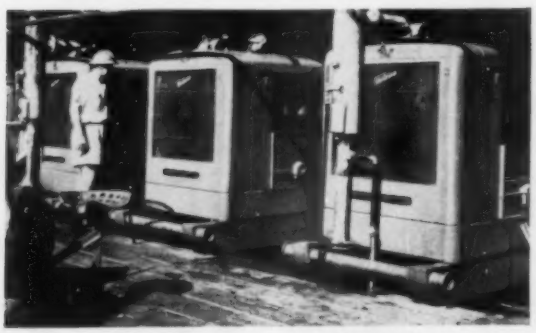


Woodfield Hoist Drilling Rig — Trinidad

Scammell Constructor — Ras Duqm, Oman

Woodfield Hoist Servicing Rig — Seria, Borneo



Petbow Generating Set — Seria, Borneo

C.P.T. Air Compressor — Iraq

ROLLS-ROYCE

OIL ENGINES

ROLLS-ROYCE LIMITED, OIL ENGINE DIVISION, DERBY, ENGLAND

Measurement Short Course, West Virginia University, Morgantown, W. Va.

28-30 Instrument Society of America, International Symposium on gas chromatography, Kellogg Center, Michigan State University, East Lansing, Mich.

SEPTEMBER

3-5 Pacific Coast Gas Association convention, Fairmont and Mark Hopkins Hotels, San Francisco.

5-7 New Mexico Geological Society, eighth annual field conference, southwestern Colorado.

8-13 American Chemical Society, 132nd national meeting, New York City.

9-10 Independent Natural Gas Association of America, annual meeting, Shamrock Hilton Hotel, Houston.

9-11 American Institute of Electrical Engineers, petroleum industry conference, Sheraton Hotel, Philadelphia.

11-13 National Petroleum Association, fifty-fifth annual meeting, Traymore Hotel, Atlantic City, N. J.

19-21 Rocky Mountain Oil Show, fairgrounds, Casper, Wyo.

22-25 American Society of Mechanical Engineers, petroleum mechanical engineering conference, Mayo Hotel, Tulsa.

23-25 American Society of Mechanical Engineers, fall meeting, Statler Hotel, Hartford, Conn.

26-27 Western Petroleum Refiners Association, Rocky Mountain regional technical-industrial relations meeting, Henning Hotel, Casper, Wyo.

26-27 Mid-Continent Oil and Gas Association, Louisiana - Arkansas division, Roosevelt Hotel, New Orleans.

30-Oct. 2 American Oil Chemists' Society, 1957 fall meeting, Netherland Plaza Hotel, Cincinnati.

OCTOBER

1-2 Texas Mid-Continent Oil and Gas Association, thirty-eighth annual meeting, Texas Hotel, Fort Worth.

2-4 Golden Trend Oil Show, Pauls Valley, Okla.

6-9 Society of Petroleum Engineers of American Institute of Mining, Metallurgical, and Petroleum Engineers, fall meeting, Adolphus, Baker, and Statler Hilton Hotels, Dallas.

7-9 American Gas Association, annual convention, Kiel Auditorium, St. Louis.

7-11 American Institute of Electrical Engineers, fall general meeting, Morrison Hotel, Chicago.

10-11 California Natural Gasoline Association, thirty-second annual fall meeting, Huntington-Sheraton Hotel, Pasadena.

10-12 American Society of Mechanical Engineers, American Institute of Mining, Metallurgical & Petroleum Engineers, fuels conference, Chateau Frontenac, Quebec.

13-15 American Association of Oilwell Drilling Contractors, seventeenth annual meeting, Mayo Hotel, Tulsa.

13-19 OIL PROGRESS WEEK.

17-18 American Institute of Mining, Metallurgical, and Petroleum Engineers, Southern California petroleum section, fall meeting, Biltmore Hotel, Los Angeles.

17-19 Four Corners Geological Society, second field conference, Gallup, N. M.

20-22 National Association of Oil Equipment Jobbers, annual convention and trade show, Hotel Peabody, Memphis.

24-25 Western Petroleum Refiners Association, regional technical-industrial relations meeting, Rufus Garrett Hotel, El Dorado, Ark.

25 Natural Gasoline Association of America, southern regional meeting, Washington - Youree and Captain Shreve Hotels, Shreveport.

27-29 Independent Petroleum Association of America, annual membership meeting, Statler Hilton Hotel, Dallas.

31-Nov. 1 American Association of Petroleum Geologists, Mid-Continent regional meeting, Cimarron Ballroom, Tulsa.

NOVEMBER

3-8 Society for Nondestructive Testing, second international conference, Hotel Morrison, Chicago.

6-8 Gulf Coast Association of Geological Societies, seventh annual convention, Roosevelt Hotel, New Orleans.

6-8 Society of Automotive Engineers, national fuels and lubricants meeting, Hotel Statler, Cleveland.

11-14 American Petroleum Institute, thirty-seventh annual meeting, Conrad Hilton Hotel and Palmer House, Chicago.

22 Natural Gasoline Association of America, Panhandle Plains regional meeting, Herring Hotel, Amarillo, Tex.

DECEMBER

1-3 Interstate Oil Compact Commission, annual meeting, Tulsa.

1-6 American Society of Mechanical Engineers, annual meeting, Statler Hotel, New York.

8-11 American Institute of Chemical Engineers, annual meeting, Conrad Hilton Hotel, Chicago.

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PRESSURE CONTROL OTIS SERVICE - EQUIPMENT

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the mud program is right to save you money

Savings begin even before spudding when the Magcobar team is working for you. A planned mud program — planned even before the rig is on location — saves money throughout the entire operation. These planned savings show up all along the line: in faster rate of penetration, in less downtime, and in economies from mud that is properly conditioned for logging and cementing.

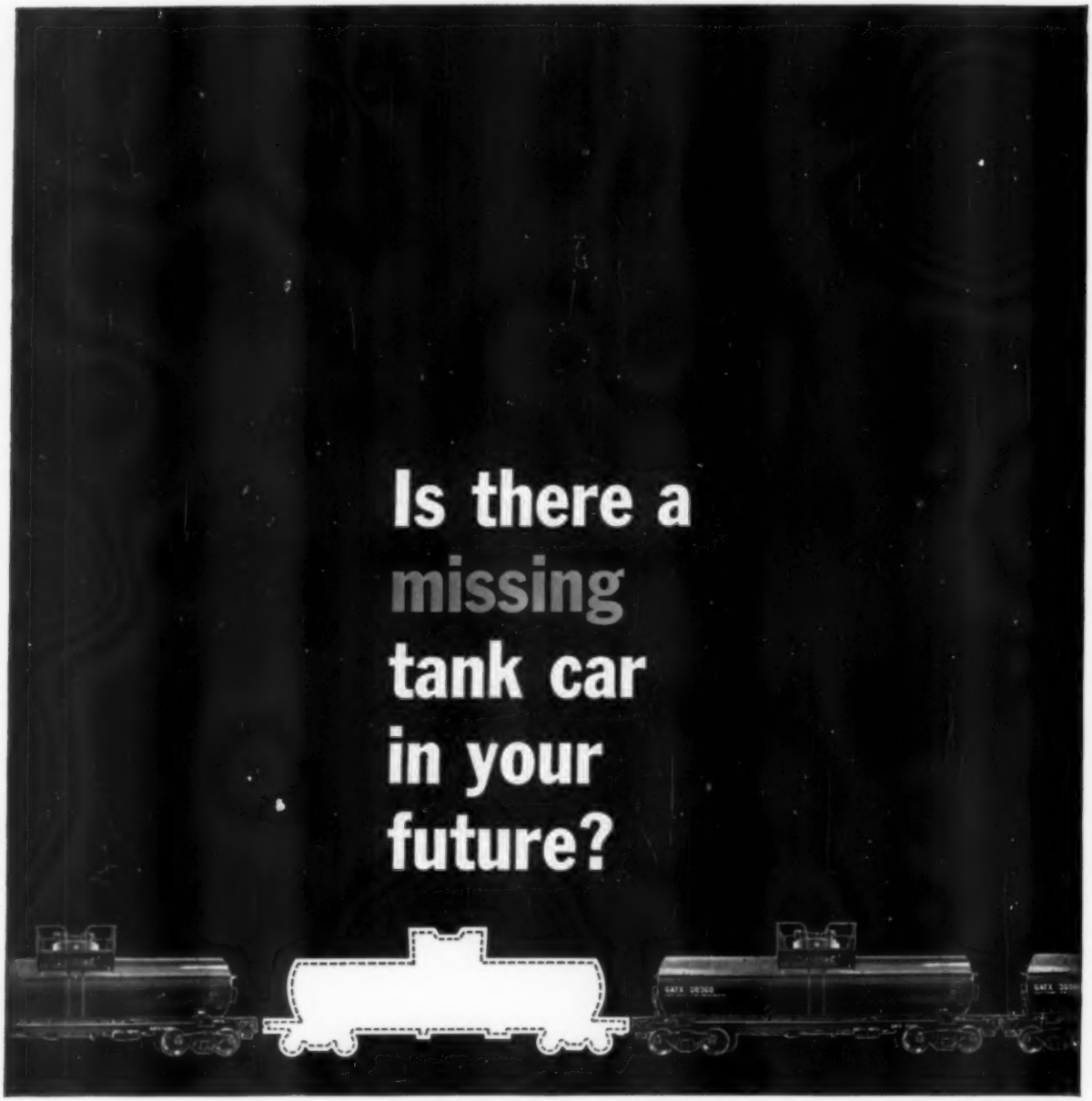
A planned mud program will lower your over-all cost per foot of hole. You will have utilized everything modern drilling mud science has developed to insure safe, economical drilling.

Plan ahead! Plan now to make full use of Magcobar's *complete* drilling mud service on your next well. You get the best drilling mud chemicals. You get the mud industry's best trained and qualified engineers. You get the *full* facilities of Magcobar, the industry's largest producer of drilling mud.

Magnet Cove Barium Corporation
Houston, Texas

Magcobar
Complete
DRILLING MUD SERVICE

57-100



That's almost certain to be the plight of companies who don't plan for their tank car requirements in the decade ahead. It's no secret that available general-purpose tank cars are going to be limited. With normal obsolescence of today's facilities, the continuing steel shortage, and with forecasts pointing to a more than 50% expansion in our economy, *liquid product shipments may be difficult . . . may miss tomorrow's sales opportunities.*

P. S. Plan now to discuss your long-range needs with our GATX District Man. You'll find . . . it pays to plan with General American.

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The OIL AND GAS JOURNAL

TULSA, OKLAHOMA

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JOURNALLY SPEAKING

A Well Is a Well Is a Well

ALWAYS on the *qui vive* to improve service to our readers, our favorite oil publication last week inaugurated a change in the monthly tabulation of well completions.

From now on this table will carry two additional columns. Condensate completions are broken out of the listing of crude-oil completions. And service wells are listed separately from those dry holes that the operators didn't intend to be dry.

This small change may mean nothing at all to those who consider a well a well. But certain statisticians and other minutia-minded purists in the industry who are not satisfied to let well enough alone have been clamoring for this more detailed tabulation. We are glad to oblige.

But so far we have not been able to satisfy those who want a more exact definition of a wildcat, or a breakdown of wildcats into various categories. In general we follow the rule of thumb that a wildcat is a well drilled 1 mile or more from established production. But the definition of a wildcat varies from company to company, from area to area, and sometimes with the whimsey of the scout reporting it.

And, of course, there are different kinds of wildcats, depending on the location, geological information, and the motivation of the operator. It has been suggested that there is a need for subclassifications of wildcats. For people who like that sort of thing it would be just the sort of thing they would like.

To meet this need we are giving some consideration to a scientific system of wildcat nomenclature recently proposed to the Pacific Coast Oil Scouts and Landmen's Association by Frank S. Parker. He has divided wildcats into appropriate classes and has devised names taken from the Greek which (he says) will give anyone specific information about each type.

Just to give a general idea of how the system works, here are some of Parker's principal categories:

Holocats (from the Greek *holo,* meaning true or complete) for those wells previously called by the unscientific term "sure-shot" wildcats. In this category Parker puts wells which the uninformed would be inclined to call wildcats but which in the mind of the operator are not really wildcats at all. Such an operator may be in possession of scientific information, technical readings, records of various gadgets which would tell him definitely that he is directly over a large river of oil. To judge by some recent lease costs, many wells located on leases obtained on sealed bids are really holocats.

Telecats (from *tele,* meaning distant); wells sometimes described as wild, wild, wildcats.

Mesocats (from *meso,* meaning in the middle, or intermediate); wildcats not as wild as telecats but still pretty wild.

Paracats (from *para,* meaning side by side); really stepouts, since they're pretty close to proven production.

Campocats (from *campo,* meaning field); wildcats within the limits of a defined field, often called new-pool wildcats.

Quasicats (from *quasi,* meaning having some resemblance to); wells that might be either wildcats or field wells depending on what the operator claims on completion; not to be confused with crazycat, which has a different etymological origin.

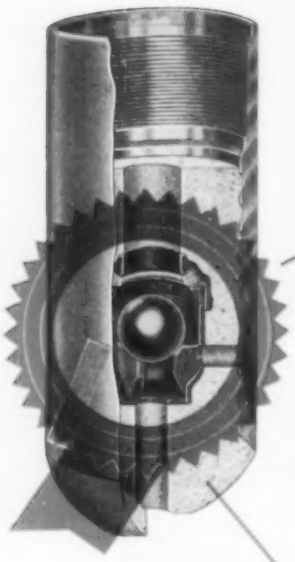
Parker admits that some wildcats may be on the borderline between two of his categories, but his system provides a simple and scientific solution to this problem: just combine prefixes. For instance, if a well is nearer a telecat than a mesocat, call it a *telemesocat;* but if it's not quite that wild, call it a *mesotelecat.* Likewise there would be *paramesocats, campoparacats,* and so on.

Carrying the system into further refinements, we have the prefixes *clino* (slant-drilled), *hypo* (over water or offshore), and *pseudo* (false, such as a sneak strat test). Thus a directionally drilled core test from the shore under the ocean would be a *pseudohypoclinocat,* and a slant hole on the edge of a field would be a *paracampoclinocat.*

The beauty of this system is its simplicity, flexibility, and provision for every possible contingency. So far, though, we haven't decided to adopt it.

—*Henry D. Ralph.*

Through the years...
today and for many tomorrows...



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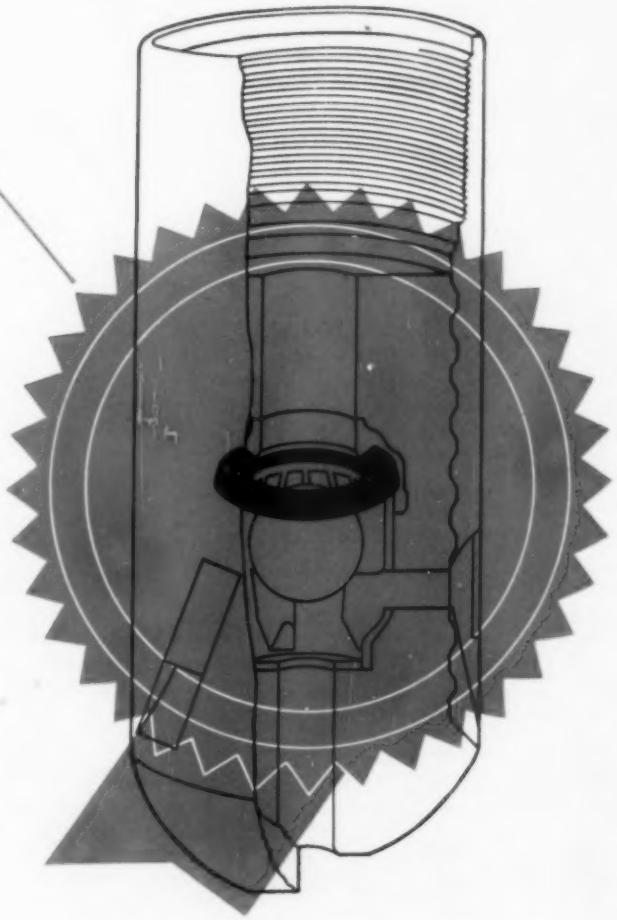


BAKER OIL TOOLS, INC.
HOUSTON • LOS ANGELES • NEW YORK

Last chance to avoid federal oil control

WITHIN the next 30 days a small handful of refining companies will determine whether federal control gets a foot in the oil door.

They must decide whether they will voluntarily comply with an imports program to be laid down by the Government. If they don't, the Government will start regulating their imports.

This moment of decision has been threatening for months and years. Now it is the eleventh hour. The Eisenhower administration is determined to limit crude-oil imports. It will act fast. It is offering importers one more chance to accept a voluntary plan before ordering federal controls.

SOME IMPORTERS—reportedly a big majority by volume—have agreed to adhere to a limitation formula if the Government can offer one that is specific, equitable, and workable.

Some others—reportedly a small minority—have not accepted—as yet. Their last chance will come within the month. By that time the administration should have perfected a limitation plan that overcomes the vagueness and other imperfections of its 1955 proposal.

There are strong indications that the new plan will be such that it can be applied in either of two ways: By federal fiat, or by good faith following individual pledges by the importers affected now and for the duration of the plan. The choice will be made by a handful of importers.

The federal control proposed is a minimum control. It may consist only of relating total imports to some statistical measurement of domestic conditions, and applying a mathematical formula to divide the total into individual quotas.

This much federal control looks innocent, simple, and strictly limited in scope. If it went no further it would be quite tolerable. But how many simple, innocent, little seeds of federal control remain that way?

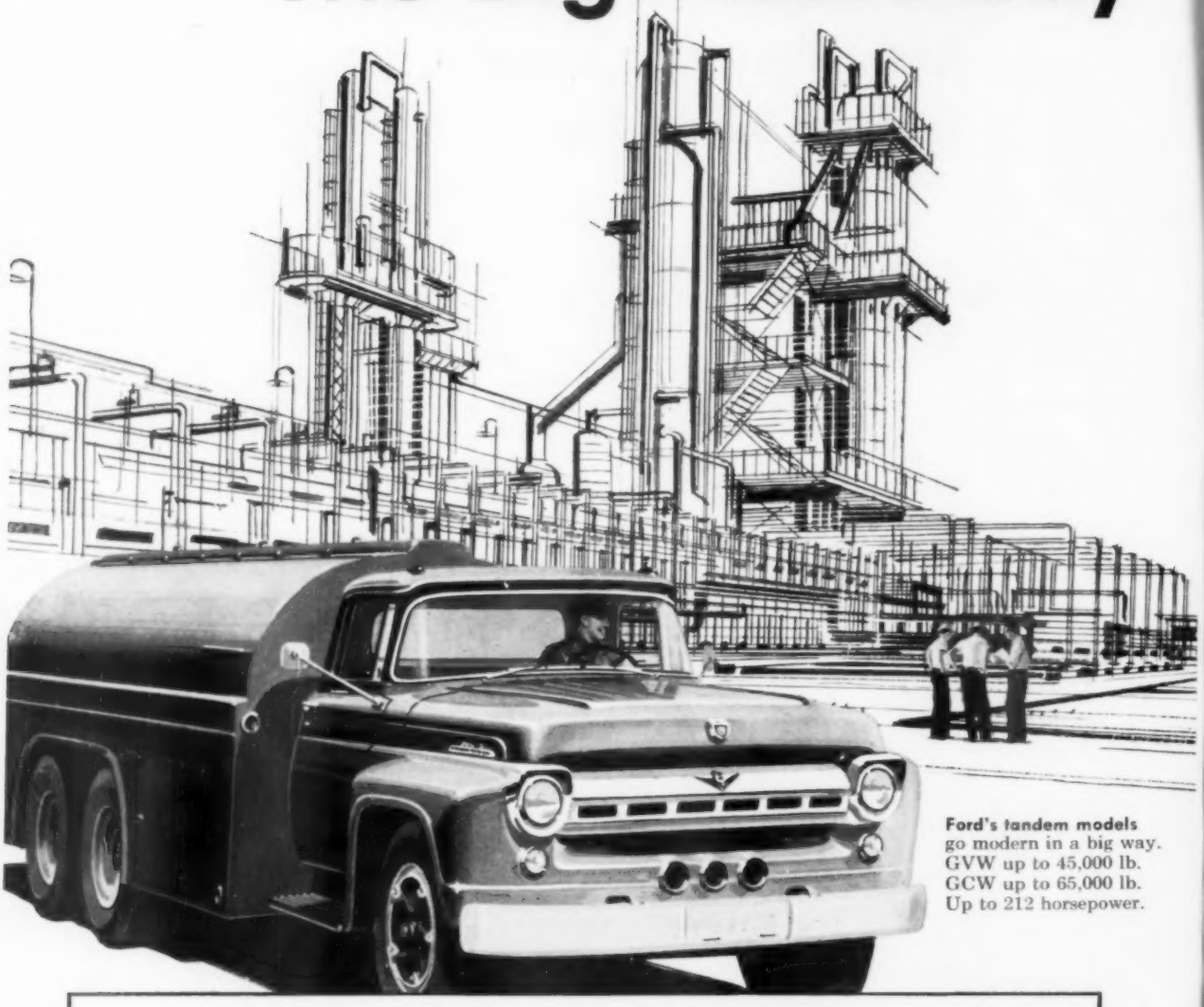
Terrific pressures would build up (backed by very plausible reasoning) to extend federal interference in the industry just a little more in one direction and then another. Once a regulatory process starts to grow it has no logical stopping place.

ONE OF THESE DAYS Washington might be telling each state how much oil it may produce, dictating conservation practices, determining distribution patterns and market prices. That's no idle fancy. Look what happened with agricultural products. Look at natural gas.

The entire industry would prefer a voluntary solution. But the great bulk seems ready to risk a little federal control rather than endure unrestricted imports.

The decision for the entire industry—a decision that may be irrevocable—will be made by a handful of importers this month.

The Big Fleets buy



Ford's tandem models go modern in a big way.
GVW up to 45,000 lb.
GCW up to 65,000 lb.
Up to 212 horsepower.

ONLY FORD GIVES YOU ALL THESE MODERN FEATURES

NEW Heavy Duty V-8 engines now have 4-barrel carburetion standard. Fresh-air intake with new thermostatic control optional on 302 and 332 V-8 engines. Dual exhausts also available.

NEW Styleside pickup bodies, standard at no extra cost. America's biggest pickup bodies! Built wider with all-steel rugged box section corner reinforcements and recessed taillights.

NEW riding comfort! Smarter, roomier Driverized cabs and completely new chassis suspension with rubber-cushioned springs provide greatly improved riding comfort and handling ease.

NEW power advances! New higher horsepower, new freer breathing, new higher compression ratios, new Super-Filter air cleaner. New advancements from camshafts to carburetors.

NEW automatic transmission for Medium and Heavy Duty trucks! Transmatic Drive ends the strain of constant shifting . . . torque-converter and six forward speeds automatically provide correct application of power. Fordomatic Drive is available for Light Duty models.

NEW chassis strength! New frames, up to 13% stronger. New sturdier springs and axles!

FORD TRUCKS COST LESS

LESS TO OWN — LESS TO RUN — LAST LONGER, TOO!

more FORD TRUCKS than any other make!

Why? . . . because on-the-job performance and low operating costs prove FORD trucks cost less!

Take a tip from the men who buy trucks every year. Official truck registration data shows that owners of America's biggest commercial truck fleets are buying more Ford trucks than any other make!

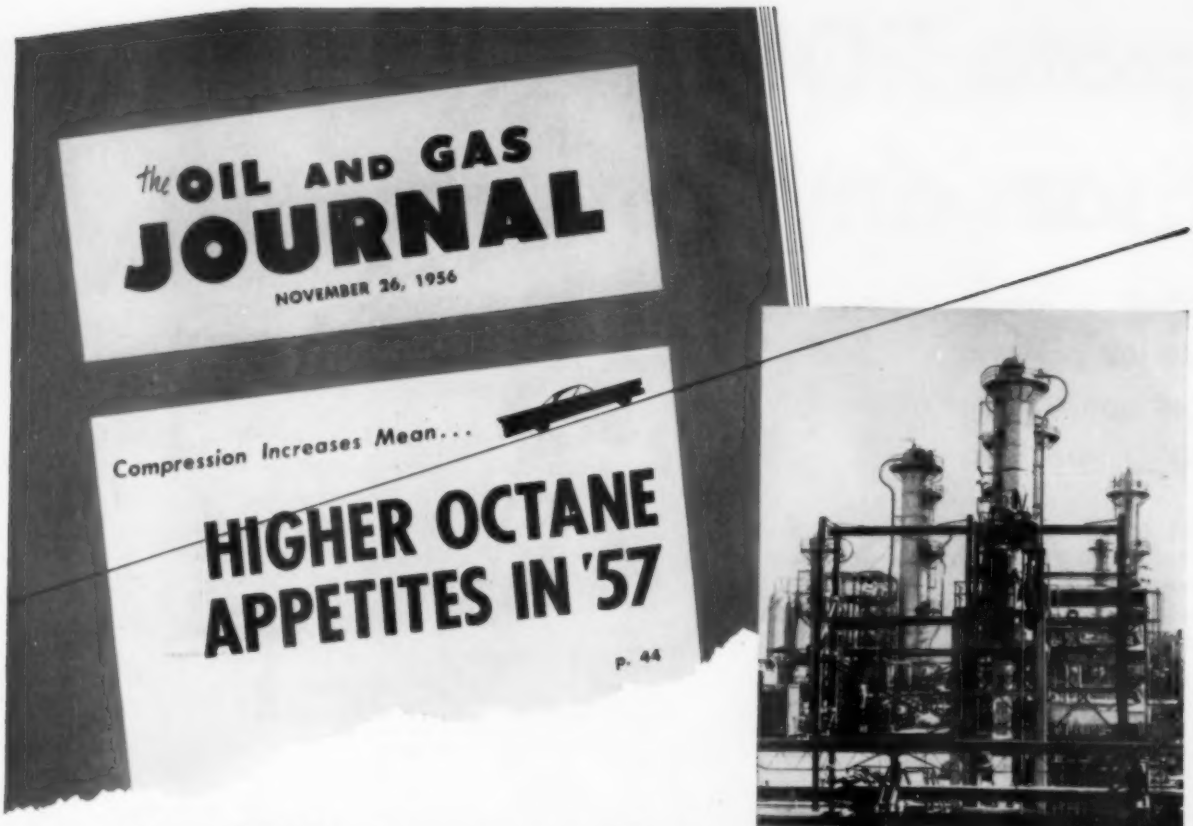
Petroleum transporters, large and small, have found Ford trucks are best for their fleets, too. To begin with, Ford's initial costs are low. Many models are priced below all competitive makes. For example, the new Ford Tilt Cab models are America's lowest-priced!*

And it costs less to run a Ford truck! Thanks to modern Short Stroke power and sturdy chassis construction, operating costs and "shop time" are reduced. Another important Ford plus is longer truck life—a fact certified by independent insurance experts.

Add it all up—you'll find Ford trucks do cost less! Contact your Ford Dealer . . . let him show you why the big fleets are buying more Ford trucks than any other make.

Based on comparison of manufacturers' suggested retail prices

New Tilt Cab line offers six series from 18,000-lb. GVW to 60,000-lb. GCW. All the advantages of "cab forward" compactness, plus better engine accessibility.



Booming high octane market spurs alkylation...

Monel resists HF corrosion... permits safe, non-stop operation for a year or more

Boosting pool octane values calls for quantity as well as quality in the premium fraction.

So, in HF alkylation, the heat's on for (1) high-stream velocity and (2) non-stop operations.

But with increases in stream velocity, the HF corrosion rate may go up. Without special protection, more inspection shutdowns are called for.

To get around the impasse producers rely on Monel

Major operators have increased their onstream time to a year or better by using Monel* nickel-copper alloy freely in critical equipment. One company reports a two-year inspection schedule.

These companies depend on Monel alloy to resist both aqueous and anhydrous HF attack at elevated temperatures and pressures.

In acid regenerators, steam reboilers, feed pre-heaters, condensers, fractionating towers... Monel alloy or Monel-clad construction provides years of trouble-free life.

In valve, pump, and instrument parts with close tolerances, it eliminates undesirable build-up of corrosion products. As relief valve rupture discs and gaskets, it helps assure safe operation.

Chances are, Monel alloy could help you increase throughput and operate safely over longer periods.

Look into the matter today. Write Inco's Corrosion Engineering Section.

*Registered trademark

When to consider Monel for HF alkylation equipment. Monel nickel-copper alloy provides useful resistance to HF in all concentrations and (in unaerated solutions) up to 250°F. It is used with the anhydrous acid at temperatures up to 1100°F. Monel is comparatively unaffected by high stream velocities. Its strength and wear resistance are high.

INCO Nickel Alloys

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

Monel ... for minimum maintenance

the OIL AND GAS JOURNAL

July 1, 1957

Imports Curb Certain, Maybe in July

● Cabinet committee now at work will determine how the flow of foreign oil will be regulated. The target: A plan that can be handled voluntarily, but which can be enforced by Government if importers don't cooperate. Date: As soon as possible.

WASHINGTON. — President Eisenhower is moving fast to put a lid on imports of foreign crude oil.

Action is expected soon—possibly as soon as 2 or 3 weeks.

It will probably take the form of a formula for assigning quotas to importers, rather than either a tariff or quotas on foreign countries.

Still under hot discussion in the Cabinet is whether the importer's quotas will be enforced by the Government or whether the individual importers will be asked to voluntarily conform to the quotas assigned them.

Pressure on the White House to do something to curb imports has been terrific in recent weeks. It has intensified since Texas cut its July allowable to 13 producing days.

This pressure caused the President to drop his original plan for a study by a commission of disinterested citizens. To speed proceedings he has turned the job over to half a dozen Cabinet officers whose departments have something to do with oil and foreign trade.

This Cabinet group held its first meeting June 24. It is scheduled to work intensively on the problem for the next 10 days.

Consultants to the group include Gordon Gray, director of the Office of Defense Mobilization; Arthur S. Flemming, former ODM director; Robert B. Anderson, recently nominated to be Secretary of the Treasury; and Herbert Hoover, Jr., former Assistant Secretary of State.

Why the rush? . . . On April 23 ODM certified to the President that there is reason to believe that crude oil is being imported into the United States in such quantities as to threaten to impair the national security.

Two days later Eisenhower stated that he agreed with this and would have an investigation made to determine the facts, as required by the so-called defense amendment (Section 7 of the Trade Agreements Extension Act of 1955).

At the same time he asked ODM to see whether imports might be limited by individual voluntary action of the importing companies.

At that time it was Eisenhower's intention to have the study made by a group of prominent citizens not connected with either the oil industry or the Government. He had difficulty getting acceptances from persons he wanted. Also it became evident that such a study might take several months.

Meanwhile time was running and oil surpluses were piling up. So he turned the job over to his Cabinet with orders for a virtual "crash program."

Tariffs are out . . . The course of the Cabinet study is expected to run about like this:

Tariffs will be ruled out—in spite of a recent statement by the President that tariffs looked like the simplest solution.

To curb imports substantially, a tariff would have to be so high that consumers would suffer. It would discriminate against high-cost foreign oil (outside Canada and Venezuela) and favor the lower-cost Middle East. Since the objective is to foster national defense by placing maximum reliance on the most accessible oil (rather than outright protection of domestic industry), a flat tariff would defeat the purpose.

Also, raising tariffs would be contrary to the administration's foreign-trade policy and would raise havoc with dozens of trade agreements in effect with other nations.

Some consideration may be given to novel types of tariffs. One such suggestion is that a tariff (or landing charge) be imposed on oil brought in by tanker but not by pipeline—thus favoring Canada. Another is that a tariff be graduated upward with the distance the oil travels from foreign field to U. S. port of entry. Another: Higher tariffs on oil from countries which buy less U. S. goods.

The State Department, however, is expected to take the stand that any such indirect discrimination would violate our favored-nation policy.

Best bet: Quotas . . . Country quotas will be ruled out. They would be discriminatory and cumbersome.

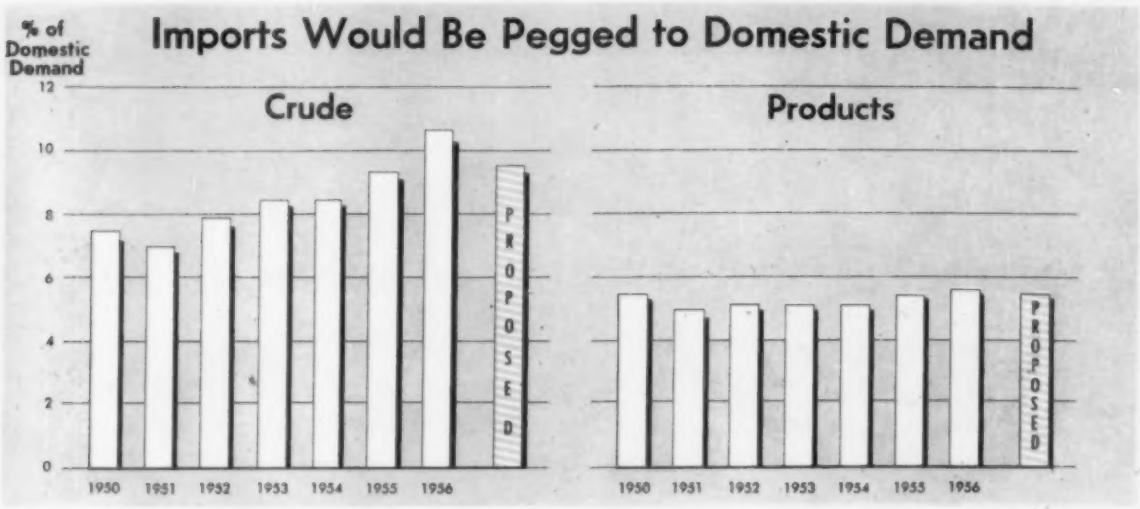
That leaves quotas on individual U. S. importers, with each importer free to choose his own source of foreign oil. Formulas must be devised fixing the total imports (such as a ratio to domestic production, refinery runs, or demand); dividing the total among U. S. importing regions (with possibly different treatment for some); and assigning an individual quota to each importer.

Such company quotas would be specific and based on an equitable formula. Provision must be made for growth in demand and for entry of future importers. Various plans for doing this are under study.

Finally comes the question: After specific quotas are assigned to individual importers, will the Government enforce them or will it depend on moral suasion for compliance?

This is the biggest decision now facing the administration.

The Cabinet committee which will make that decision includes Sinclair Weeks, Secretary of Commerce, chairman; Charles Wilson, Defense; George Humphrey, Treasury; John Foster Dulles, State; Fred A. Seaton, Interior; and James P. Mitchell, Labor.



Texas Gulf asks "minimum control" in . . .

. . . Newest Plan for Limiting Imports

A DETAILED FORMULA for limiting oil imports is being urged on the Government and the industry by Gordon W. Reed, chairman of the board of Texas Gulf Producing Co., New York and Houston.

It is only one of half a dozen or more which have been suggested to the Office of Defense Mobilization by oil men. But it is the only one which is being widely publicized and promoted by its author.

Reed's plan is known to be under study by government officials. It is quite possible that important features of it may be incorporated in the imports-control plan now being drafted by the Eisenhower Cabinet (page 79).

In brief, the Reed plan calls for the ODM to issue import certificates to refiners now using foreign oil. Provision is made for new importers to get certificates in the future. No oil could be imported without a certificate.

Total imports would be limited to 15 per cent of U. S. domestic demand for all oils, computed quarterly from the Bureau of Mines forecasts of demand. Of the total, 9.5 per cent would be assigned to crude and 5.5 per cent to refined products of all types.

How it works . . . First the total would be divided among four regions: Atlantic Coast, Gulf Coast, Pacific Coast, and Canadian border (east of the Rockies). Each region's share would be the percentage of total imports that it imported during 1956.

Within each region the allowable would be divided among refiners by a mathematical formula. Each refiner's quota would be his percentage of 1956 imports into his region. A calculation is included to provide quotas for refiners which started importing during the past 2 years.

New importers would get certificates only as U. S. domestic consumption increases. One-half of each region's share of 15 per cent of increased demand would be divided among new refineries applying for certificates. The remainder of the increase would be spread among previous importers.

Reed says he has spent many months studying this and other plans. He has discussed his plan with government officials and with many importers, refiners, domestic producers, and foreign operators. Reaction, he says, has been generally favorable. He is actively urging ODM to recommend it to the President.

Reed heads a medium-sized independent domestic producer without refining facilities or foreign production. However, his company has concessions in Libya and hopes to be a foreign producer and perhaps an importer.

In drafting his plan he drew heavily on his experience in setting up quotas and priorities while head of the metals division of the War Production Board during World War II.

Reed lays down these specifications for any successful plan to control imports:

. . . **Have a minimum** of government control and bureaucracy.

. . . **Maintain** competitive incentives —not try to protect everybody "from cradle to grave."

. . . **Base future actions** on future conditions rather than past history.

. . . **Start with** the current competitive condition and depend on the growth factor to take care of newcomers.

. . . **Provide for** about 95 per cent of the anticipated troubles and don't worry about the others until they arise.

. . . **Cover refined products** as well as crude.

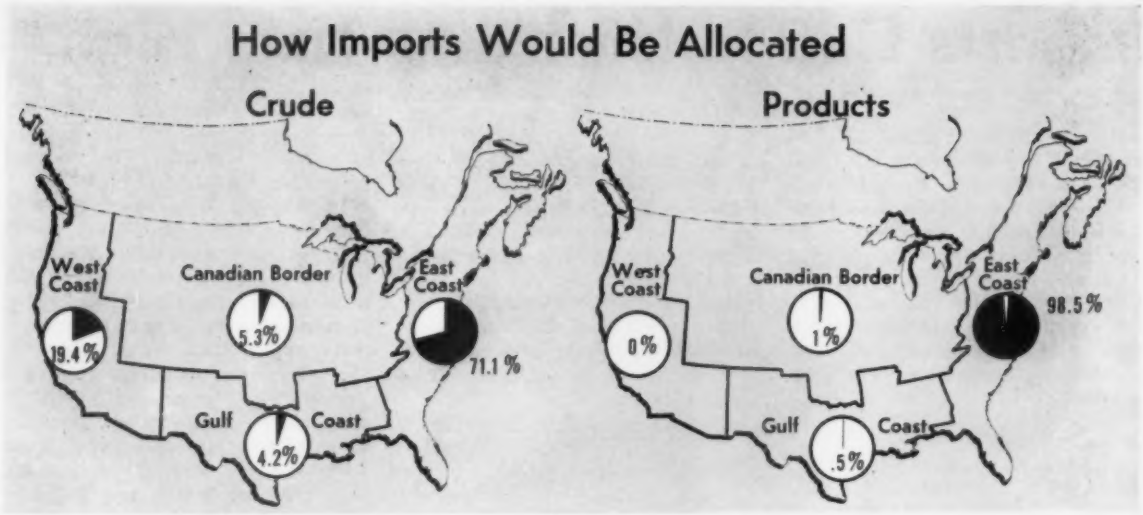
. . . **Treat all foreign** countries alike.

. . . **Make it firm** enough so that all concerned can plan for several years in advance.

Reed says his plan meets all these specifications better than any other he has seen. But he doesn't claim it is perfect. He invites suggestions for modification and improvement, but he warns against making the plan too cumbersome in an effort to provide for all possible future contingencies.

He wants the plan to remain unchanged for 5 years, after which ODM would appoint a citizens' committee to review it. This long a period of stability is necessary for oil operators to plan properly, he insists. But he feels that ODM should have sufficient administrative discretion to make minor adjustments in the formula if conditions warrant.

If this formula were in effect today, crude imports during the last half of 1957 would be limited to 885,000 bbl. per day, compared with actual imports



of 979,000 the last half of 1956 and 824,000 the last half of 1955.

Product imports under the Reed formula could be 523,000 bbl. per day this half, compared with 473,000 the last half of 1956 and 430,000 the last half of 1955.

Reed himself makes these comments about his plan:

... **It discards** the recommendation of the President's cabinet committee that imports be held to the 1954 ratio of domestic production because:

Competitive conditions have changed in the past 2 years; if domestic production should fall off for any reason, imports would automatically be cut and consumers would suffer; a forecast of the period immediately ahead is a better basis for quotas than the history of a past period.

... **The 15 per cent** of the market allocated to imports is a more-or-less arbitrary figure.

In 1954 imports had 13.5 per cent; in 1956 they had 16.14 per cent. The breakdown of 9.5 per cent for crude and 5.5 per cent for all products is about in line with recent history, though if applied in 1957 it would cut crude a little and raise products proportionately.

... **Products are included** in the plan because "a barrel of oil displaces a barrel of oil" in whatever form.

If crude is limited but not products, there might be a trend toward building foreign refineries to ship products to the U.S., and this should be nipped in the bud. But for the next few years the plan could be applied to crude only, with no restrictions on products other than the existing tariffs.

... **The plan could** be put into effect by executive order, without legislation. Lawyers have advised that the President could do this under the so-called defense amendment.

... **A minimum of control** by the Government is involved. Importers' quotas are computed under a mathematical formula. Permits are surrendered at the customs house before crude can be imported. ("The whole system could be run by one stenographer and an adding machine," says Reed.)

... **All countries** are treated alike. An import permit could be used for crude of any origin. No foreign country could complain of discrimination.

... **The only real hardship** will be on those who have increased their imports rapidly in the past couple of years and on those who may want to become big importers in the future—but the whole object of the plan is to put the brakes on exactly those people.

Reed has printed his plan and voluminous supporting data into a fat book which he has distributed rather widely. He says criticisms of it fall into three classes:

... **Those who pick small flaws** or raise questions about peculiar contingencies which might arise. (Reed says the ODM should have enough discretion to make the plan practical and workable, and that perfecting amendments would be quite acceptable.)

... **Those who say** the plan in general is good but some particular factor in the formula should be changed. (Reed says that in each such case the change would directly favor the particular company raising the objection.)

... **Those who refuse** to accept the thought that any sort of government control over imports is inevitable.

Other persons who have studied the Reed plan agree rather generally with most of his specifications for a workable plan, but they find more than minor faults with his specific proposals. Among these are:

... **Products** should not be limited at this time. Products imports are not as serious as crude imports and are not likely to be in the near future.

Including products would complicate the plan and create more opposition from consumers and jobbers. Furthermore, ODM's certification to the President covers crude only and makes no mention of products. A whole new study would have to be made if products are to be limited.

... **The share** of imports in each of the four border regions is frozen for 5 years with no provision for flexibility. It is quite possible that in one region, say the West Coast, demand would increase faster than the national average while regional production declines.

... **For defense** and other reasons it is proper to give some preferential treatment to Canadian oil.

... **Refiners** who have held their imports to ODM requests would be hurt worse than those who ignored the voluntary plan.

... **A new refinery** could get an import quota, but an established refinery wishing to run a little foreign crude could not.

Eisenhower's cabinet committee is known to be considering Reed's plan together with several other proposals for setting an import limit and allocating it among regions and among companies. All the arguments made for and against the Reed plan doubtless are also being weighed against other proposals.

If, as now seems likely, the administration will decide on quotas rather than tariffs, some elements of the Reed formula may well be incorporated in the system—whether the company quotas are enforced by the Government or simply assigned with a request for voluntary compliance.

Imports Due to Hit an All-Time High

AUSTIN. — Imports of foreign crude will hit an all-time high mark this month and remain above the million-barrel-daily mark through the fall.

The Texas Railroad Commission revealed that picture on controversial imports while officials in Washington pondered what action to take to put a curb on the flow of foreign oil. The commission's estimates were based on reports from importing companies doing business in Texas, and did not take into account any control plan.

The commission figures indicate that 1,216,200 bbl. daily of foreign crude will be brought into this country in July. If this amount actually is brought in, it will set a record. The previous high month was July 1956, when 1,084,000 bbl. daily was imported.

First million-barrel-daily month probably will be June. The reports on actual imports aren't in yet, but the commission estimate put June cargoes at 1,120,000 bbl. daily. That's a gain of 16.5 per cent over June last year.

Imports for May totaled 979,800 bbl. daily. The outlook after July's peak will be a dip to 1,201,700 bbl. daily in August, 1,166,200 bbl. daily in September and 1,127,900 bbl. daily in October. All months represent gains ranging from 9 to 23 per cent above the same months a year ago.

Importers' Plans Through October

(Thousands of barrels daily)

	—Actual*—		—Estimated or forecast*—				
	May 1956	May 1957	June 1957	July 1957	Aug. 1957	Sept. 1957	Oct. 1957
CRUDE—EAST COAST:							
Atlantic Refining Co.	64.0	62.9	69.0	69.0	69.0	69.0	69.0
Cities Service Co.	33.5	22.8	28.3	34.6	38.3	35.0	31.5
Eastern States Pet. Co.	32.1	7.7	12.0	20.0	12.0	15.0	20.0
Gabriel Oil Co.	5.4		7.3	7.1	7.1	7.3	7.1
Gulf Oil Corp.	126.0	98.0	135.0	155.0	158.0	158.0	158.0
Hancock Oil Co.	1.8	(††)	(††)	(††)	(††)	(††)	(††)
Lake Superior Ref. Co.	5.3	2.9	5.2	5.2	5.2	5.2	5.2
McBride Oil & Gas Co.	(††)	(††)	(††)	(††)	(††)	(††)	(††)
Phillips Petroleum Co.	14.2	16.1	12.0	11.6	11.6	12.0	11.6
San Jacinto Pet. Co.	1.7	(††)	(††)	(††)	(††)	(††)	(††)
Signal Oil & Gas Co.	1.7						
Sinclair Oil Corp.	69.1	72.6	77.5	77.5	78.6	77.7	75.2
Shell Oil Co.	1.0						5.0
Socony Mobil Oil Co., Inc.	74.1	62.9	68.5	78.2	78.2	78.2	79.7
Sohio Petroleum Co.	1.7			7.5	7.5	7.5	9.0
Southwestern O. & R. Co.		3.7	3.8	3.6	3.7		
Standard Oil Co. of Calif.	82.0	72.6	86.5	86.5	86.5	86.5	86.5
Standard Oil Co. (Ind.)	17.1	42.5	53.5	56.0	56.4	56.7	53.2
Standard Oil Co. (N. J.)†	74.0	71.0	86.0	91.0	91.0	91.0	89.0
Sun Oil Co.	30.1	21.8	46.3	41.3	51.3	44.2	51.3
The Texas Co.	64.3	65.2	75.2	82.7	82.7	73.0	55.2
Tidewater Oil Co.	14.5	90.6	82.1	87.3	94.5	77.0	72.5
Total East Coast	713.6	713.3	848.2	914.1	931.6	893.3	879.0
CRUDE—WEST COAST:							
Douglas Oil Co. of Calif.		(††)	(††)	(††)	(††)	(††)	(††)
Shell Oil Co.		56.9	53.0	71.9	59.5	71.9	41.5
Socony Mobil Oil Co., Inc.	47.6	29.2	26.5	26.5	26.5	26.5	26.5
Standard Oil Co. of Calif.	17.1	71.1	58.2	58.2	58.2	58.2	58.2
The Texas Co.	46.3	12.4	27.2	35.4	20.3	20.5	20.0
Tidewater Oil Co.	39.2	42.6	59.2	66.3	62.6	52.8	59.7
Union Oil Co. of Calif.	13.3	23.0	23.8	19.8	19.0	19.0	19.0
Wilshire Oil Co.	19.8	31.3	24.0	24.0	24.0	24.0	24.0
Total West Coast	183.3	266.5	271.9	302.1	270.2	272.9	248.9
Total crude	896.9	979.8	1,120.1	1,216.2	1,201.7	1,166.2	1,127.9
PRODUCTS:							
Asiatic Petroleum Corp.	4.3	10.2	8.0	8.0	8.0	8.0	8.0
Eastern States Pet. Co.	9.6	14.9	7.0	3.0	3.0	3.0	3.0
Gabriel Oil Co.	1.0						
Gulf Oil Corp.	3.0				3.0		
Shell Caribbean Pet. Co.‡	112.0	132.0	183.0	166.0	150.0	167.0	176.0
Shell Oil Co.	28.9	22.8	19.0	21.0	23.3	23.7	20.9
Socony Mobil Oil Co., Inc	7.9	13.9	11.0	11.0	11.0	11.0	11.0
Standard Oil Co. of Calif.		4.9	11.7	11.7	11.7	11.7	11.7
Standard Oil Co. (Ind.)§	26.6	20.0	13.2	7.8	20.2	23.4	28.6
Standard Oil Co. (N. J.)†**	188.0	184.0	196.0	185.0	185.0	185.0	252.0
The Texas Co.		4.2	3.5	7.8	3.5	3.5	3.5
Total products	381.3	406.9	452.4	421.3	418.7	436.3	514.7
Total crude and products	1,278.2	1,386.7	1,572.5	1,637.5	1,620.4	1,602.5	1,642.6
Bonded fuel included	91.1	109.9	106.0	103.8	103.5	103.2	101.9

*From company reports to the Texas Railroad Commission. †Based on quarterly estimates. ‡Imported by independent distributors. §Received through suppliers who can furnish either domestic or foreign oil. ‖Mostly duty free for bunkering ships in foreign trade. **Includes bonded drawback for foreign flag international bunkers as follows: May, 54,000 bbl. daily; June, 54,000 bbl. daily; third quarter, 52,000 bbl. daily; fourth quarter 51,000 bbl. daily. ††Did not report to the commission.

Some trends . . . Several other significant signposts stand out in the current Railroad Commission report.

. . . Canadian imports will slip slightly in July.

. . . Middle East and Far East will pick up most of the gain in shipments to this country while Latin America holds steady to its market.

. . . West Coast imports will step up faster than those on the East Coast.

Several of these trends are tied closely to a drop in tanker rates for the West Coast.

As for the Middle East story generally, imports from that region still were influenced by the Suez crisis as late as May. They will begin to hit top stride again this month.

Big volumes . . . Actually July and August may compete for the top month.

Estimates put July crude imports at 1,216,200 bbl. daily compared to 1,207,700 for August. The difference is in the cargoes going to the West and East Coast.

West Coast shipments in July are expected to average 302,100 bbl. daily, a gain of 58.2 per cent over the amount brought in for the same month last year. They will dip to 270,200 bbl. daily in August.

On the East Coast, July shipments will reach 914,000 bbl. daily or 12½ per cent more than the same month last year. But they will move up to 931,600 bbl. daily in August.

ORIGIN OF CRUDE IMPORTS

(Thousands of barrels daily)

Origin—	May* 1956	May† 1956	May† 1957	July† 1957
Canada	89.6	48.0	137.0	104.8
Latin America	511.3	508.2	625.2	625.5
Middle East	306.8	310.6	179.6	407.9
Far East	30.2	30.1	38.0	78.0
Total	937.9	896.9	979.8	1,216.2

*Actual, Bureau of Mines. †Reported to the Texas Railroad Commission.

State Wins Round

● Louisiana's boundary case broadened to include all Gulf Coast states

WASHINGTON. — The Supreme Court will decide next year whether the states bordering the Gulf of Mexico have a 3-mile or a 3-league boundary.

The court last week broadened the Government's suit against Louisiana to include all the gulf states from Florida to Texas.

Its unsigned order, in which Justices Warren and Clark did not participate, was a setback for the Justice Department, which had asked the court for an immediate ruling that Louisiana's boundary was 3 miles beyond the low-water line.

At the same time, the court sustained Louisiana's plea that the boundary should be set only after a thorough review of the issue.

The court brought the other states into the case by granting them 60 days in which to intervene. The court ordered the Government to file an amended complaint adding as parties in addition to Louisiana any states that do not intervene in that time.

What court said . . . "The court is of the opinion that the issues in this litigation are so related to the possible interests of Texas and other states situated on the Gulf of Mexico in the subject matter of this suit that the just, orderly, and effective determination of such issues requires that they be adjudicated in a proceeding in which all interested parties are before the court," the order said.

Warren and Clark have not taken part in the case because, as former governor of California and Attorney General of the U. S., respectively, they had had an interest in the tidelands issue.

The big issue in the case is the interpretation of the 1953 "tidelands act" giving states their submerged resources out to the 3-mile limit.

The gulf states contend that the law leaves the way open for them to prove they are entitled to a greater boundary by reason of the fact that they had a 3-league limit when they entered the Union.

The Justice Department argues that when the states entered the Union they came in on "an equal footing" with the other coastal states. It contends that the territorial limit of the United States is 3 miles, and that no state may have a boundary beyond that of the nation.

watching WASHINGTON

. . . with Bertram F. Linz

Defense line fades—again . . .

THE question of a West Texas-California crude pipeline has been studied back and forth, up and down for several years. The latest verdict: There's even less need for it now than when government aid was denied 2 years ago.

The line, frequently in the news as repeated attempts to get government backing were made, again got the spotlight recently from Sen. Joseph C. O'Mahoney's oil-probing subcommittee. O'Mahoney heard and reared up at charges that a "monopoly" on the West Coast had thwarted the project.

That charge fell down with a thud last month. Mobilization Director Gordon Gray disclosed that the ODM's position was based on an analysis of the West Coast transport problem made, not by oil men, but by three men not connected with the industry.

The analysis supported previous findings by the ODM, the Office of Oil and Gas, and the military that there is no defense need for the line. On the contrary, Gray told O'Mahoney, the West Coast today is in a stronger oil position by reason of new refinery capacity, crude supplies from Canada, and increased gas supply.

And, Gray added, any views the major West Coast companies might have against an independent pipeline were never considered by the ODM. Defense needs, and those alone, was the sole factor.

Corn still just fodder . . .

A PRESIDENTIAL commission on new uses for surplus crops told Congress last month that butadiene from corn is a "promising possibility." It could well be part of a $100-million research program backed by farm bloc members.

Last week five top administration officials gave the idea the boot. Even the Agriculture Department, which stood to benefit from the research program, turned it down. How to make butadiene from alcohol is already known, the department said. And how to make alcohol from corn has been known for centuries.

The Treasury, which would have to finance the project, also is against it. Not only is there more than enough butadiene in sight to meet all needs, Undersecretary W. Randolph Burgess said, but the Government made a tacit promise when it sold its synthetic-rubber plants that no unsold plant would be used in any part of the synthetic-rubber industry.

Asphalt and airstrips . . .

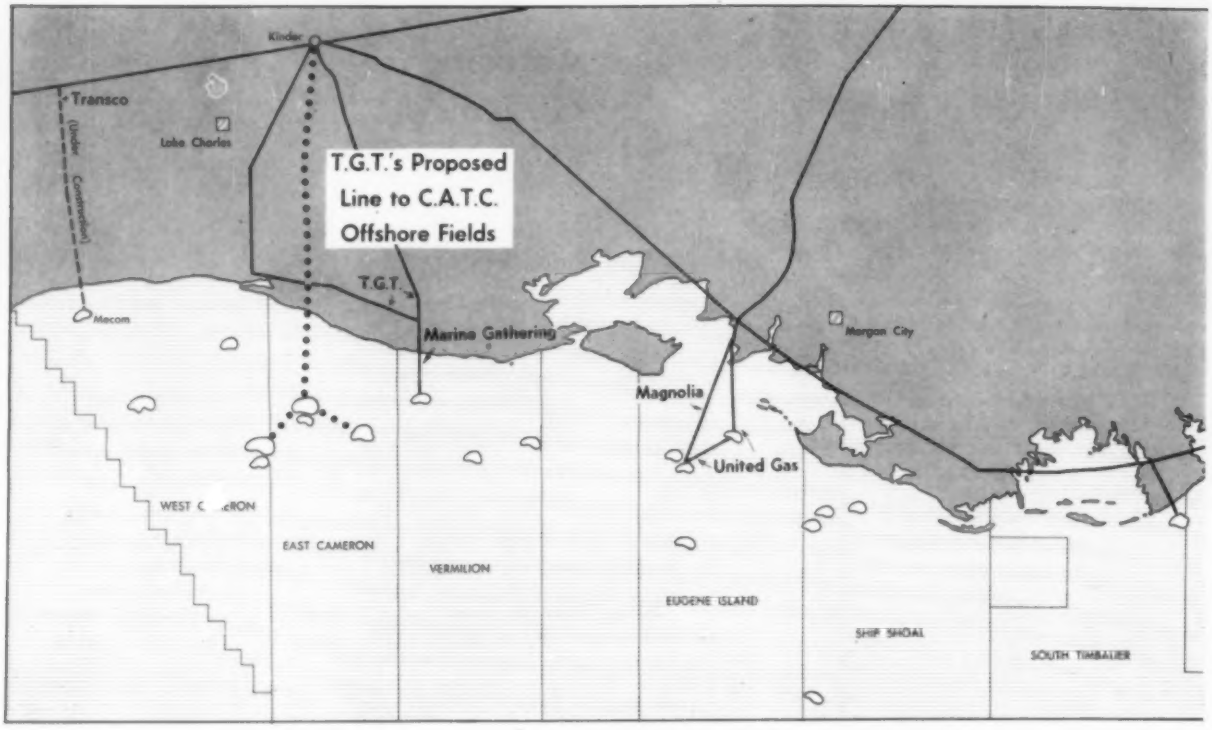
THE old fight over the use of asphalt on military airfields is back in the news.

A House subcommittee spent several days digging into the subject last week. It heard military spokesmen explain why the services can't use more asphalt. Then industry experts told why they could and should.

This is a row that has been going on for years. Until 1954 the military allowed a 5 per cent differential for concrete. After Congress aired the matter the differential was cut out.

This was supposed to put asphalt and concrete on a strictly competitive basis when used for noncritical areas. But actually, it is charged, the Air Force has leaned toward higher-cost concrete exclusively for airstrips.

The military insists that only concrete can be used on the last 1,000 feet at each end of runways and areas where planes are warmed up. But this leaves much larger areas open for either concrete or asphalt. The asphalt people say they can give the military an equal or better surface at lower cost.



FPC Reversal Will Set Off New

A TURNING point in the economics of offshore operations may have been reached last week.

Prospects of a better price for natural gas will spark a new surge of activity in waters of the Gulf of Mexico.

That's the interpretation oil men are putting on latest ruling of the Federal Power Commission. The agency reversed its field in pricing the offshore gas produced by the C.A.T.C. Group.

Briefly the ruling is this: C.A.T.C. Group (Continental, Atlantic, Tidewater, Cities Service) can charge 21.4 cents per M.c.f. for gas plus 1-cent gathering charge in a contract with Tennessee Gas Transmission Co.

The FPC earlier had said it would approve the contract only for 17 cents per M.c.f. plus 1-cent gathering. C.A.T.C. threatened to cancel out the deal and Tennessee Gas Transmission appealed for a rehearing. This resulted in the reversal.

FPC, however, in approving the higher price said it would make a "prompt investigation" of the reasonableness of the contract price. Rates of Continental, Tidewater, and Atlantic already were under study. Similar inquiry was ordered on Cities Service Production Co.

What it means . . . Offshore producers, elated at the turn of events, saw these consequences of the FPC ruling:

. . . An early boom in construction of offshore pipelines.

. . . Increased development drilling as operators go back to open up temporarily abandoned gas fields.

. . . Natural gas shouldering more of the load in financing further drilling in the gulf.

. . . FPC precedent for higher gas prices. The agency apparently has given official recognition to two facts; Big gas reserves are worth more per cubic foot than small ones. Drilling and producing costs must be considered in setting the price of gas.

Prospects bright . . . The new price, which is 20 per cent higher than T.G.T. is paying elsewhere in the Southwest, is bound to encourage rapid development of offshore gas fields.

For the first time in the history of offshore operations natural gas will become a highly important economic factor.

To date, gas has accounted for only about 10 per cent of total revenue from offshore fields. Without a significant increase in gas production and without what they consider a realistic price for their gas, many operators could see their chances of a payout growing dim. Now their prospects are suddenly brighter.

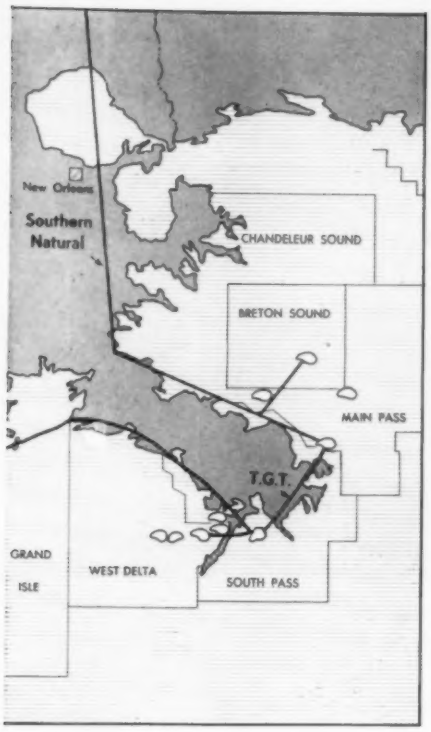
During the first year, T.G.T. is committed to move up to 175 million cubic feet of gas per day. In volume that would represent a jump of about 50 per cent over current gas production in the Gulf of Mexico. But in dollars, the increase will be close to 100 per cent.

Over the life of the contract, the single purchase could involve close to $2 billion. Reserves committed to T.G.T. by the C.A.T.C. Group are undetermined. They are estimated at 2 trillion to 6 trillion cubic feet. Escalation clauses provide for a starting price of 22.4 cents per M.c.f. and a peak price of 35.4 cents starting in 1986.

The other plans . . . Lack of pipelines in Gulf of Mexico has delayed development of some of the biggest uncommitted gas reserves in the nation.

In this case, federal price controls almost stalled development of the huge C.A.T.C. reserves off Cameron and Vermilion parishes.

It was a loudly whispered secret in the industry that the C.A.T.C. Group had other plans for its gas if



Activities

the FPC balked at the price involved. The four-company group, with Continental as operator, reportedly had plans to build its own line to shore if the T.G.T. deal fell through. There was speculation that the gas would be kept off the interstate market and thereby free from FPC controls.

According to one report, Continental and Cities Service were thinking of using part of the gas at their Lake Charles petrochemical plant. Some lawyers had held that the gas then would not be subject to controls as interstate gas. And the plant presumably could use enough of the gas to permit the companies to retain their offshore leases from the federal Government.

Whatever its plans, C.A.T.C. made it clear that it was not bluffing in turning down the lower price set by the FPC in its original ruling. Tennessee Gas then based its appeal to the FPC for another hearing on grounds that eastern consumers eventually would be the ones to suffer under its decision.

Huge reserves . . . It's difficult to assay the full impact of the ruling on the economics of offshore operations.

While daily crude production off the coast of Louisiana has risen nearly 50 per cent in the past year, gas production has remained almost static. Operators were forced to hold it off the market.

Natural gas already tapped in the Gulf of Mexico would meet the needs of the world's largest transmission system for nearly 20 years at today's capacity. And most of this gas has been found accidentally, while in search of oil. Potentially, the Gulf of Mexico—especially the Louisiana sector—is considered one of the country's best gas-producing areas.

Gas reserves discovered to date off the Louisiana and Texas coasts are estimated at about 14 trillion cubic feet. That's comparable to proved recoverable reserves in all of Oklahoma, itself one of the major gas-producing states. Yet while Oklahoma in 1956 was producing more than 900 billion cubic feet of gas, the offshore area was producing approximately 98 billion.

If pipelines were available so offshore gas fields could produce at their M.E.R., the tidelands oil gamble soon could be on a pay-as-you-wager basis. At present operators figure they are losing about $10 million a month on their collective operations in the gulf.

The loss on day-to-day operations is attributable largely to restrictive oil allowables.

While oil is fighting to maintain existing markets, pipelines are looking constantly for big new gas reserves. There are three potential buyers for every decent gas reserve discovered in the Gulf of Mexico. They are willing to pay the price to get it to market. And there's plenty of material and equipment to start laying some big lines to shore.

Price the barrier . . . The problem is to get the gas to shore at prices allowing a profit to the producer and the transmitter while keeping it competitive with other fuels. The new FPC decision should make this possible.

So far, most offshore gas wells have been about as profitable as dry holes. They built up the operator's confidence, but they added nary a shekel to his bank account.

The history of offshore gas production to date generally has followed the pattern of remote gas-producing regions on land.

In the early stage of exploration gas wells are plugged while the rigs move on to look for oil. If enough gas is found, sooner or later somebody wants to build a pipeline to transport the gas to market. But until pipeline plans begin to materialize, development drilling is slow and, usually, quite accidental. The driller is always hoping the next well will produce oil.

So crude production was expected to jump off to a much faster start in the tidelands than gas production. The pattern is dictated by economics. Nobody can afford to build a pipeline until he's reasonably sure he can find plenty of gas to go through it.

Exploration in the gulf now has advanced far enough—and successfully enough—to warrant several large-diameter pipelines.

The delay has been due primarily to economics. Pipeline companies were willing to pay the price. They obviously felt the consumer would be, too. But the FPC, in following a policy which hasn't been too successful even on land, was trying to hold the price down.

One major oil company figures its offshore wells cost nearly five times as much as onshore wells. Yet the FPC temporarily voided a sale setting the price of offshore gas at a scant 40 per cent above the onshore rate.

Worth a premium . . . Because of the tremendous reserves involved in the C.A.T.C. sale, the gas could have commanded a premium price even if it had been on the mainland.

Privately, some of T.G.T.'s competitors admit they considered the price reasonable. Some of them would like to buy gas at the same price if they could find it in the same volume.

Despite the FPC's restraining influence, the trend for gas prices is upward. According to the Bureau of Mines, the average wellhead price for Texas gas 5 years ago was 6.2 cents per M.c.f. Last year, while seeking reserves for a line to Florida, Coastal Transmission Corp. bid up to 16 cents for gas at the extreme south tip of Texas. This gas, of course, is much farther from the big consumer markets than are most of the offshore fields.

Patience, then, appeared to be the answer for major operators in the gulf. But patience has its limits. And, in this case, the limit is set by law—August 1958. At that time, many of the offshore leases, including the C.A.T.C. acreage involved in the deal with T.G.T., are subject to cancellation unless production has been established.

Projects . . . Both C.A.T.C. Group and Tennessee Gas are losing no time in getting started on pipeline facilities to put the gas deal into operation.

Marine Gathering Co. has been awarded contract for building a submarine line to gather oil and gas for C.A.T.C. Group off Grand Isle, La. (See map). It will be the first job for

First Load: Tidewater Oil Co.'s newest supertanker makes its first call at Tidewater's newest refinery. The S.S. George F. Getty eases its 375,000-bbl. load into the terminal at the ultramodern Delaware City refinery. The crude will be processed into 100-plus octane gasoline. The 52,680-ton vessel is the first of four supertankers of its size to be placed in service by Tidewater this year. The giant 130,000-bbl. refinery, which was dedicated in May, was built at a cost of $200,000,000. Six of its eleven process units are the largest ever built.

Marine Gathering's new pipe-laying barge, "Magic," which was commissioned last spring.

The gathering system will extend from Grand Isle to Block 47 field. It will include about 25 miles of 6, 8, and 12-in. pipe. Construction will begin immediately. Completion is set for about September 1.

The line will be designed to transport both crude oil and gas which will be separated at the Grand Isle terminal. Ultimate crude capacity will be about 45,000 bbl. daily.

Plans call for lines to be buried at least 3 ft. under the gulf floor with the short end of the main line buried to a depth of 10 ft. Submarine trenching work will be done by Collins Construction Co.

Construction of the T.G.T. line to shore also is expected to begin at once. The company is awaiting only formal acceptance of the federal certificate by the C.A.T.C. partners.

Brown & Root, Inc., is expected to lay the offshore portion of the line.

New offshore network . . . The offshore system will include about 25 miles of 26-in. pipe from East Cameron Block 49 to shore. About 30 miles of smaller laterals are proposed to connect Blocks 62 and 71 in the East Cameron area and Blocks 192 and 193 in West Cameron.

The project also will include about 46 miles of onshore line to connect with the existing system near Kinder, La. Cost of the entire job is estimated at more than $16 million.

There already is speculation that T.G.T. will extend the system later to tap other offshore reserves in the area.

Transcontinental Gas Pipe Line Corp., now building its first offshore line, also is looking for a significant gain in offshore gas production. The company's 16-in. line to West Cameron Block 45 will have a daily capacity of about 110 million cubic feet, more than three times its first-year throughput.

Transco has contracted to pay Mecom Petroleums an initial price of 16 cents per M.c.f. for Block 45 gas. The line to shore is due to be completed in mid-July. The field has proved reserves estimated at about 88 billion cubic feet, based on completion of nine wells. Actual reserves, however, are likely to be greater.

Southern Natural Gas Co., which is already buying some gas near the mouth of the Mississippi proposes to extend its lines in the Breton Sound and Main Pass areas. The company has negotiated for new reserves held by Kerr-McGee Oil Industries, Inc., Phillips Petroleum Co., Union Oil Co., and Magnolia Petroleum Co. Starting price for its new offshore gas supply has been set at 20.25 cents per M.c.f.

Principal offshore gas lines now in service include:

. . . T.G.T.'s Muskrat system which picks up production from a short distance from the coast in Bay Marchand, Main Pass, South Pass, and West Delta regions. Most of this production is from Shell Oil Co., The California Co., and C.A.T.C. leases.

. . . Marine Gathering Co.'s line in the Vermilion area. T.G.T. buys gas moved through this line. Production is primarily from Pure Oil Co.'s Block 39 field.

. . . United Gas Pipe Line Co.'s line from Blocks 32 and 51 fields off Eugene Island.

. . . Magnolia - Continental - Newmont's line which serves several fields off Eugene Island. The line transports both oil and gas.

Uncommitted gas . . . In addition to the reserves committed to existing or proposed offshore pipelines, there are large volumes of gas still awaiting a market.

Among the largest offshore gas fields without pipeline connections in sight is Superior Oil Co.'s Block 149 in West Cameron area. This field, with 14 productive wells shut in, has reserves now estimated at 175 to 200 billion cubic feet.

Superior also has large reserves in Block 71, West Cameron, and Blocks 71 and 76 of Vermilion area. Much of Superior's offshore gas was originally committed to American Louisiana Pipe Line Co. for its Detroit market.

In the Ship Shoal area, Gulf Refining Co. and Humble Oil & Refining Co. have a gas field at Block 176 more than 40 miles from shore. Kerr-McGee and associates have untapped

gas in Blocks 28, 30, and 32 of the same area.

Near shore in the West Delta and Main Pass areas Magnolia, California Co., and C.A.T.C. have shut-in gas still awaiting an outlet.

In the past, most of the gas production off Louisiana has been from the Eugene Island area eastward to the Delta country. Yet the western part of the offshore region is considered "gassier" than the eastern half. So far, most gas in the western sector has been found farther from shore.

Though actual offshore gas reserves discovered to date are estimated at about 14 trillion cubic feet, proved reserves are placed at slightly more than 4 trillion. It will take a lot of drilling to find out if the reserves are as big as they look. Now with a market assured there's more incentive to drill.

Some restraints . . . The FPC order had an element of compromise in it.

The FPC took up the C.A.T.C. offer to amend the contract to provide continuing supervision over future price increases in event the Harris bill is enacted into law. The amendments would provide that if the Harris bill is passed, the price would escalate every 4 years up to the then current reasonable market price but not more than 2 cents per M.c.f.

T.G.T. admitted in the FPC hearing the price is higher than it is paying for other gas. But the company declared that cost of the offshore gas at the Kinder station is less than that for West Texas gas bought at a lower price but costing more to haul to Kinder.

The FPC accepted the contract price with this explanation: "Important as is the issue of price, as far as the public is concerned, the precise charge that is made initially is less important than the assurance of this great supply of gas."

The new investigation of the companies' rates will assure that "relief can be afforded to the consuming public if it should be found that the price to be charged for the offshore gas is excessive," the FPC pointed out.

A dissent . . . The only dissenting vote against the order came from Commissioner William R. Connole.

He charged that the FPC had bowed to pressure and now was in the position of having to prove that the rate was more than reasonable. The commission and the consumers are in a dilemma: Denial of essential supplies on the one hand and inadequate protection against unjust and unreasonable rates on the other, he said.

U. S. Steel Increases Prices

OIL MEN started paying higher prices for their steel goods this week—ranging from $8 to $15.50 a ton.

The higher prices were posted by U. S. Steel Corp., price leader of the industry, in announcements to its subsidiaries late last week. The new prices are effective July 1.

Other steel producers traditionally follow U. S. Steel's postings.

The U. S. Steel announcement stated the price increases averaged about 4 per cent for carbon and alloy types. This made the hike $6 a ton on basic prices.

Oil country up more . . . Prices for oil-country goods, however, took a higher jump.

Here are the advances on typical oil-country items:

. . . $8 more for buttweld pipe ½-4-in. black and galvanized, plain ends; seamless 2⅜ to 24-in. black and galvanized; and seamless and electric weld, 5 to 24-in., black and galvanized.

. . . $6.50 more for electric weld line pipe, 26 to 36-in.

. . . $9.50 more for oil-country casing, J-55, short T & C, all sizes.

. . . $10.25 more for oil-country tubing, J-55, upset T & C, all sizes.

. . . $15.50 for drill pipe, "D," internal upset, all sizes.

. . . 4.5 per cent more for alloy seamless pressure and mechanical tubing.

. . . 5.5 per cent more for carbon seamless pressure and mechanical tubing.

The fifth increase . . . The new prices mark the fifth time since 1955 that oil men have seen the costs of steel increase.

Basic prices advanced $7.35 a ton in 1955 and $8.50 a ton in 1956. In addition there were price "corrections" in 1956 and earlier this year.

U. S. Steel President Clifford F. Hood declared last week the higher prices were necessary to meet added wage costs. He said steel wages went up 6 per cent on July 1 and the new price structure will add only 4 per cent to steel income.

Other provisions of a 3-year agreement signed last August with members of the United Steel Workers of America, gave workers 21 cents an hour more starting this week. This includes a 4-cent hourly cost of living boost. The workers received 24 cents an hour more last August after the contract was signed. They also got a 3-cent cost of living adjustment this January.

Market soft? . . . The new prices were posted in the face of a softening market for oil-country goods.

A survey made recently by The Oil and Gas Journal showed this situation: Deliveries are nearly current. Cancellations of advanced bookings are more prevalent. Extra tonnage has been made available to the oil industry. All the developments made more steel available for oil work than just a few months before (OGJ, June 17, p. 98).

Reasons for the softer market were attributed to less drilling, bad weather, and more conservative buying patterns in the industry.

Audrey Halts Offshore Drilling

HOUSTON.—Four drilling tenders broke loose from pilings in the Gulf of Mexico last week as hurricane Audrey swept through the Cameron and Vermilion offshore areas.

One of the tenders, operated by the C.A.T.C. Group, had drifted about 3 miles as the storm pushed inland toward the Port Arthur-Lake Charles region.

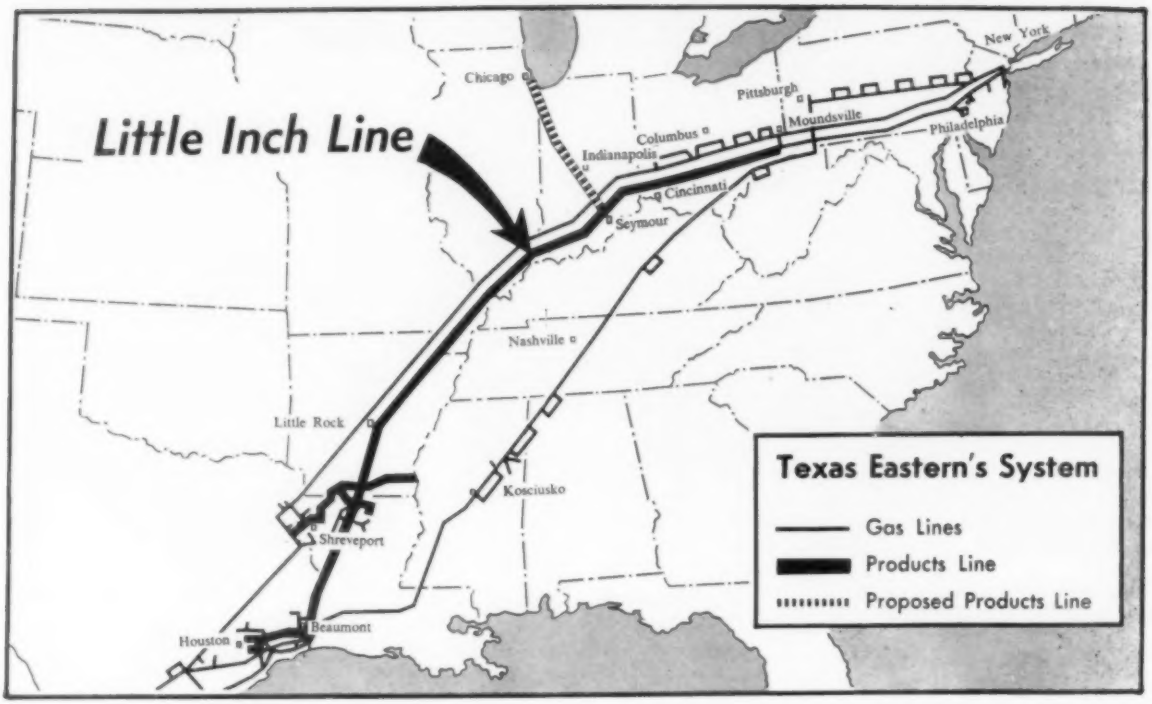
The four tenders reportedly broke their bow lines which were tied to pilings. At last report they were swinging their ship anchors. A skeleton crew of about eight men was believed to be on each tender.

A mass evacuation of drilling rigs was ordered as the hurricane moved northward toward the offshore oil area. Nearly 2,000 crew members were moved to shore before the storm hit.

Wind velocities of 100 miles per hour, with gusts up to 140 miles per hour, were reported in the area off Cameron Parish. A spokesman for Continental, operator of four rigs in the storm area, said waves about 35 ft. high accompanied the hurricane.

Only one major accident involving offshore oil equipment had been reported as the storm hit the coastal area. Nine crewmen were missing from a fishing boat which crashed into a drilling platform and sank about 11 miles off Galveston.

The hurricane appeared to be the most severe storm ever to hit offshore rigs in the Gulf of Mexico. There are more than 100 rigs in the area.



Little Inch Is Making History Again

● Products from the gulf will be flowing into markets in the Midwest within 3 months. Conversion will be just the latest big move for a big but still growing company

SHREVEPORT.—The Little Big Inch pipeline, Uncle Sam's answer to the tanker shortage in World War II, is due to be pumping products again in September.

The $35,000,000 conversion program already is under way. Tankage and pump stations, in fact, will be completed late this summer.

The conversion, long delayed by court battles, will be the biggest event in products pipelining since the Little Big Inch was built in 1943-44 as a companion to the Big Inch crude line.

Early last week there had been a threat of still further delay. Mississippi River barge operators, who had tied up the conversion for 2 years, went back to court again in an attempt to block the conversion. It was approved, they said, while a decision was pending in court on a complaint that FPC had acted improperly earlier in skipping the usual examiner's report on the proposal.

In midweek, though, the suit was dismissed, finally clearing the way for the conversion.

Initial capacity of the reconverted products line will be 185,000 bbl. a day. This can be increased to 250,000 bbl. daily by adding more pump stations. The system will be remote-controlled from five points.

The Little Inch was the first products line as large as 20-in. and none of that diameter has been built since. The wartime lines freed coastal tankers to supply theaters of war.

The Little Inch, operated as a gas carrier by Texas Eastern Transmission Corp. since 1947, will be switched to products from Baytown, Tex., near Houston, as far as Moundsville, W. Va., a distance of 1,168 miles. The company will lay a 231-mile, 14-in. extension from Seymour, Ind., into Chicago (see map).

The replacement of gas capacity lost in the conversion, and other expansions already approved, will result in construction of more than 1,000 miles of 30-in. pipeline by Texas Eastern this year. System capacity will increase to 1,744,000,000 cu. ft. daily. And by the end of 1958, the figure is expected to approach the 2,000,000,000-cu. ft. mark.

The Little Inch switch, approved by the Federal Power Commission June 21, climaxes the growth of Texas Eastern from an idea 10 years ago to a corporation with assets of $750 million.

This success story started with the purchase from the Government of the Inch lines from Texas to the East Coast and their conversion from crude and products to natural gas. The second decade of company operations is starting with the Little Inch reconversion as part of the business strategy of the company.

What conversion means . . . The Little Inch will be the first major common-carrier products link between the Gulf Coast and Mid-Continent refining areas and the big Midwest market.

It will affect transportation patterns from the Gulf Coast as far north as Minnesota and as far east as Pittsburgh. The Little Inch will serve a market including Arkansas, Missouri, Illinois, Minnesota, Wisconsin, Michigan, Iowa, Indiana, Ohio, Kentucky, Tennessee, West Virginia, and western Pennsylvania, either from terminals along the line or through connecting pipelines, river barges, tank cars, and tank trucks. The line will transport a full range of clean petroleum products, including L.P.G.

The Little Inch will provide cheaper transportation to shippers, a chance for better earnings for Texas Eastern, and keen competition for barge op-

CONVERSION is discussed by Millard K. Neptune, left, executive vice president, products division, and Orville S. Carpenter, Texas Eastern president. Neptune is busy lining up shippers for the old war-emergency pipeline. It will have to compete with barges for business, since, as an independently owned common carrier, it doesn't have the guaranteed throughput of a line built by a major company.

TECHNICAL IDEAS have been a major factor in the company's growth. And Baxter F. Goodrich, vice president and chief engineer, is responsible for most of them.

erators on the Mississippi, Illinois, and Ohio rivers.

The line will have the advantages of high sustained volume and the economy resulting from this type of operation. It also will have a low capital structure to support—it was built with $70-per-ton steel compared with a cost of $170 per ton if it were built today.

The major impact of the Little Inch, besides changing distribution patterns through the alternate means of transportation, will be to lower and stabilize barge rates. The competitive tariff will probably settle somewhere around the low charged by barge operators.

There is also keen interest in the effect the new products outlet will have on the Midwest market. Some marketers think it could be the means of dumping surplus Gulf Coast and Mid-Continent products in the area, thus leading to a weakening of prices. But others say the fact that many refiners who are logical shippers on the Little Inch also refine and market in the area the line will serve will be a stabilizing influence.

The main reason behind the conversion, of course, is a business one. The products system will be permitted to make a profit considerably larger than the 6 per cent to which an interstate gas line is limited.

Texas Eastern origin . . . The idea of converting the Inch lines to natural gas was promoted by E. Holley Poe, Tulsa, who was director of the natural-gas division of the Petroleum Administration for War.

The lines extended from the nation's largest producing area on the Gulf Coast to what was potentially the biggest gas market in the world. And their conversion, Poe believed, was economically feasible.

He was joined by Charles I. Francis, Houston expert on oil and gas law, in 1945. Francis provided the legal know-how essential to get the plan off the ground and to put together a group to finance and operate the natural-gas system envisioned by Poe.

To firm up gas reserves, E. DeGolyer, world renowned geologist, was brought into the picture. For engineering studies and financing help, brothers George R. and Herman Brown, of Brown & Root, Inc., international engineering and construction firm, were called in. For operations knowledge needed to run the pipeline, they chose R. H. Hargrove, who had 20 years' experience in the natural-gas industry and was at the time vice president of United Gas Corp.

Poe, as president of the newly formed Texas Eastern, submitted the successful bid for the war emergency lines to the War Assets Administration, which offered them for sale. The Government received $143,127,000, roughly what it cost to build the lines. Poe reputedly made a million dollars out of the promotion. He stepped down as president when Texas Eastern was ready to start operating, and Hargrove succeeded him.

Hargrove was killed in a plane crash January 10, 1954. DeGolyer died last December. Poe, who remained on the board after resigning as president, died March 9, 1951. George Brown is still chairman of the board and Herman Brown is a director. Francis is vice president and general counsel and also a member of the board.

Why it grew . . . Texas Eastern's growth has been speeded by the technical ingenuity which has become its trademark.

The company had to make the most of the facilities it had bought, and this is where Baxter D. Goodrich, vice president and chief engineer, came into the picture.

Goodrich was confident that centrifugal compressors could be made to work on a high-pressure, cross-country gas line. Management went along with the idea, installing centrifugals at 14 of the 21 original compressor stations.

They turned out to be highly successful. Texas Eastern was thus able to use almost everything on the products system but the pumps themselves. Projected expansion goals were attained faster and at much lower cost, and a new concept in compressor facilities was pioneered for the industry.

Another Goodrich idea which has paid off is the large, single-unit electric station in areas of low-cost power and on a line which pumps large volumes of gas the year around. This station, which has operated for a year, has the lowest investment per horsepower in the industry and low operating costs as well (OGJ, June 24, p. 110).

Texas Eastern also adapted the "pigging" operations used on petroleum lines to its gas lines, greatly increasing the efficiency through regular cleaning with scrapers. This was another first for the gas industry.

TEXAS EASTERN TRANSMISSION CORPORATION
SHREVEPORT, LOUISIANA
VOUCHER NO. 11-19
November 14, 1947
CHECK NO. 129.
PAY One Hundred Forty-Three Million Twenty-Seven Thousand Dollars - - - $ 143,027,000.00
TO THE ORDER OF The Treasurer of the United States
THIS CHECK IS IN PAYMENT OF AN OBLIGATION TO THE UNITED STATES AND MUST BE PAID AT PAR. N. P. 1-120
PAUL D. MANNING
TEXAS EASTERN TRANSMISSION CORPORATION
AUTHORIZED SIGNATURE
AUTHORIZED SIGNATURE

HUGE CHECK symbolizes beginning of Texas Eastern, which got into the natural-gas transmission business in 1947 by buying the war-emergency pipelines. Total purchase price was $100,000 greater than the amount of the check, since $100,000 was put up at the time of the bid.

The company was a leader among transmission systems in entering large-scale natural-gas storage operations. Texas Eastern joined with New York State Natural Gas Corp. in 1950 to develop the Oakford storage, largest in the world with capacity of 105 billion cubic feet, in depleted gas fields east of Pittsburgh.

This permits Texas Eastern to operate the main lines from Texas and Louisiana at near 100 per cent load factor the year around, and makes available a supply of premium-priced gas during peak winter demand. Surplus summer gas is injected into storage during the summer for withdrawal at up to 700,000,000 cu. ft. daily in coldest weather.

Expansion . . . Original capacity of Texas Eastern, before compressor stations were built on the Inch lines, was 138,000,000 cu. ft. daily using only field pressure of the gas.

By 1952, five years after the start-up, the system had been expanded to 1,200,000,000 cu. ft. daily by compressor-station additions and a new 774-mile, 30-in. line from Kosciusko, Miss., to Uniontown, Pa. The Oakford, Pa., storage was developed about this same time.

Wilcox Trend Gathering System, Inc., owned 87½ per cent by Texas Eastern, added a major source of supply to the company when it was formed in 1952 to gather gas from South Texas.

In 1953, Texas Eastern formed Texas Eastern Penn-Jersey Transmission Corp., which operates a pipeline from Oakford to the main system near Lambertville, N. J. The same year the company gained access to the New England market through Algonquin Gas Transmission Co., in which it holds 28 per cent interest.

Another milestone was the acquisition of Mexican gas reserves, which will start flowing this fall through a 30-in. line from McAllen, Tex., to Beaumont, where it joins the existing system. Texas Eastern succeeded where others had failed in attempts to tap this source. Initial delivery from Mexico will be 115,000,000 cu. ft. daily.

Mexican deliveries will increase to 200,000,000 cu. ft. as development warrants. Texas Eastern has first call on additional reserves proved in the fields which it has under contract with Petroleos Mexicanos, the Mexican Government company.

The Little Inch conversion will give the company 1,700 miles of pipeline, including the Triangle system purchased in 1955, and 61,500 hp. in products service. Natural-gas facilities will total 5,900 miles of pipeline and 539,270 compressor hp.

Diversification . . . Like many other gas-transmission companies whose earnings potential is restricted by regulation, Texas Eastern has sought business opportunities outside its principal field of activity.

The Little Inch conversion is a good example. The company is constantly looking for other money-making possibilities, President Carpenter says. It has a planning and economics section which does nothing but investigate such opportunities.

The producing division, formed in 1950, points up the expansion in areas where the potential return on investment is greater. It operates in Texas, Oklahoma, Alabama, Arkansas, Louisiana, New Mexico, Utah, Colorado, and Kansas. Texas Eastern participated in drilling 59 wells last year. "We are increasing our program this year," Carpenter says.

The producing operation is a separate business venture and is not meant to develop a gas supply for the pipeline.

Future of gas business . . . While Carpenter is interested in new opportunities, he does not minimize the future of the gas business itself.

"There is a market available for all the gas we can buy at reasonable prices," he points out. His own company's expansion—360,000,000 cu. ft. daily this year—is sufficient evidence that growth is still at a very rapid pace.

But the industry is not without its problems. One of the biggest is the high cost of money coupled with the limited rate of return. What has happened in the brief history of Carpenter's company explains why.

When Texas Eastern bought the Inch lines in 1947, it borrowed money at 3 per cent interest. This year it must pay double that rate. The same problem faces all industries which must go into the money market regularly to finance expansion. But particularly does it cramp a regulated enterprise which finds itself having to pay 6 per cent for money to finance an operation whose profit is limited to 6 per cent.

Carpenter believes that situation gives stockholders less than a fair shake. What, then, is the way out of this regulation-imposed dilemma?

One of the first steps, Carpenter says, is to convince Government that there's nothing sacred about the artificial 6 per cent rate of return. While it might have been logical at one time, conditions are no longer the same. "More flexibility is needed to regulate justly under changed circumstances," Carpenter says.

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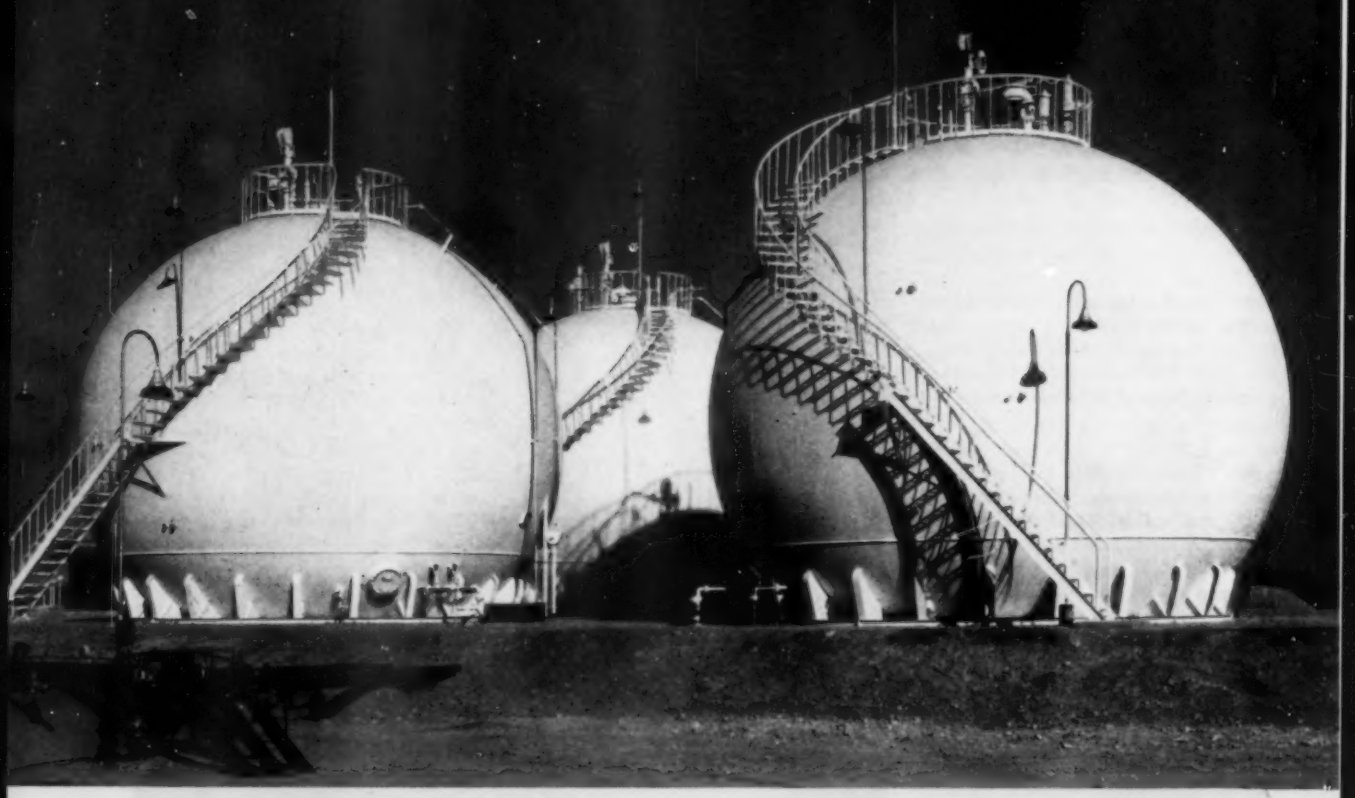

Hortonspheroids® are used to store liquids that are too volatile to hold at atmospheric pressure. They prevent breathing and boiling losses and reduce filling losses to a practical minimum. No vapor can be lost as long as the internal pressure does not exceed the settings of the pressure relief valves.

The three 3,500-bbl. Hortonspheroids above were erected for the storage of natural gasoline at the Texas Natural Gasoline Corporation, Perkin's Plant, Coke County, Texas. They are designed for 45 lbs. per sq. in. working pressure and were pickled and painted by the Horton® Pickling Process, an efficient means of removing mill scale from steel to provide a better bond between paint and metal.

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Above: Three 3,500-bbl. Hortonspheroids, built by CB&I for the Texas Natural Gasoline Corporation, Perkin's Plant, Coke County, Texas. The structures are 35 ft. in diam. and were designed for a working pressure of 45 lbs. per sq. in.

CB&I

Texas to Add More Oil

● **Commission approves four water-flood, gas-drive projects; added recovery will hit 10,000,000 bbl.**

AUSTIN. — The Texas Railroad Commission has handed out permits for four more sizable secondary-recovery programs.

The projects, two gas and two water-injection, are slated for leases in Slaughter, Levelland, and West World (Strawn) fields in West Texas and Comitas field in South Texas.

Together, they will net more than 10,000,000 bbl. of added oil.

West World (Strawn) . . . One of the largest of the projects is that planned by Continental Oil Co. for its C. T. Harris "C" lease in West World (Strawn) field of Crockett County.

Thirteen of the 36 producing wells in the 2,800-acre field are on this lease. Conoco expects to increase recovery from 15.6 to 29.6 per cent. It figures oil-in-place originally at about 21,280,000 bbl.

The company will reinject gas from the Strawn at 8,014 to 8,034 ft. The gas currently is being flared. It plans to force about 1,560,000 cu. ft. of gas daily down one input well, its No. 15, under pressure of about 2,800 psi.

The program will compliment a gas-injection operation now being carried out in the rest of the field by Cities Service Oil Co.

Slaughter . . . Sid W. Richardson, Inc., also will inject gas in a pilot operation into the San Andres under its 327-acre S. A. Slaughter "B" lease in the Hockley County portion of Slaughter field.

By reinjecting casinghead produced from the San Andres, the company expects to hike recovery by between 3,000,000 and 4,000,000 bbl.

Plans are to inject about 292,000 cu. ft. of gas daily each through two input wells in the San Andres. Injection pattern will be an inverted nine-spot.

The lease has 18 wells in two tracts. Production was established in March 1941 and is estimated to be in the late intermediate stage of depletion. The San Andres, a dolomitic limestone, is topped in the area at about 4,860 ft.

Levelland . . . Just to the northwest of Levelland field, Lion Oil Division of Monsanto Chemical Co. will flood the San Andres under its 1,785-acre Masten lease in Cochran County.

Lion estimates the pay zone under the lease originally held 19,600,000 bbl. of oil. It figures it can recover an added 2,576,000 bbl. by flooding.

The Masten lease has 42 wells producing about 6.5 bbl. daily each from the San Andres, which is topped at 4,950 ft. Lion plans to start with an 85-acre, five-spot pilot (one input well) and expand it over the lease if it is successful.

It will inject about 1,000 bbl. a day at 1,500 psi. through one input well to start. If and when expanded the project would have five inputs. Injection water supply will come from the red beds at 250 ft.

Comitas . . . Gilcrease Oil Co. expects to net an extra 1,200,000 bbl. of oil from a flood of the Mirando sand in Comitas field.

Average per-well production in the field is now down to 0.75 bbl. daily. The field is a heavy water producer —pouring out roughly 5,000,000 bbl. of water as compared with 2,320,000 bbl. of oil since discovery in 1954.

Gilcrease estimates original oil-in-place at about 8,680,000 bbl. It plans to adopt a peripheral injection plan using 10 input wells.

With the flood, Gilcrease thinks it can cut residual-oil saturation at abandonment in the flooded area to about 25 per cent.

Signal "Moves" Shore to Tap Tidelands

REDONDO BEACH, Calif.—Signal Oil & Gas Co. is getting ready to directionally drill 24 offshore wells from one onshore location here.

The big drilling program will be carried out on a man-made drill site. The company extended Santa Monica Bay's shoreline by dumping tons of dirt along the shore (see photo). Surface casing has already been set, and drilling will start soon.

The location is directly seaward from Signal's model soundproof drill site onshore, from which six slant-hole wells have already been drilled (OGJ, Feb. 11, p. 71).

Meanwhile, further up the bay, General Petroleum Corp.'s core boat, the M. V. Torrey, is gathering geological information in 56 ft. of water just off the coast of the town of Venice.

General Petroleum recently completed a similar program in 120 ft. of water on state-owned tidelands just north of the city of Santa Monica.

At Hermosa Beach, a contract is being drawn up giving Shell Oil Co. and Continental Oil Co. exclusive drilling rights to the Hermosa Beach tidelands. The two companies are paying $12,000,000 for the lease. Their joint bid included a cash bonus of $8,600,000.

L.A.C.T. Gets Nod

Phillips project in Texas approved by commission

AUSTIN.—Phillips Petroleum Co. got the green light last week from the Texas Railroad Commission to continue operating its lease automatic custody transfer system in the Texas Panhandle.

The company has had the unit on its Ranch "C" lease in Panhandle field of Hutchinson County on a guinea-pig basis. The project was one of the first to be tentatively approved for Texas. It began operating December 19, 1956, and was subject to commission review in 6 months.

The operational review went to the commission's satisfaction, and the approval order was issued last week.

Frank Lyte, development engineer for Phillips, said there has been a few mechanical failures, most of them caused by cold weather. But Lyte said the unit invariably "failed safe." The unit shut itself down in such cases before any excess oil was produced or run to the pipeline.

The unit made 257 dumps up to May 31 and handled 24,113 bbl. of oil. Thorough checks showed it to be off only 0.063 per cent from perfect measurement.

Phillips said the unit operated as planned. It found no substantial changes needed.

California Gas Outlet Ready

SACRAMENTO, Calif. — Pacific Gas & Electric Co. has completed its 75-mile gas line from Beehive Bend to Sacramento.

The new 18 and 20-in. outlet will tap Beehive Bend, Willows, Perkins Lake, and Llano Seco gas fields in the Butte-Glenn-Colusa county area. Engineers Limited Pipeline Co. had the contract for the $5-million project.

The new carrier means that General Petroleum Corp. will be able to put 19 shut-in gas wells on production. A big drilling program is not expected, since it has been the practice for several years to drill and wait for an outlet.

Another big P.G.&E. project in northern California will be ready by the end of this year. It's the 165-mile, 12-in. gas line from Corning field in Tehama County, northwesterly to the Eureka area. Initial capacity of this line will be 21,000 M.c.f. daily. Contractors will use three spreads for the $9,400,000 project. Corning is about 30 miles north of Beehive Bend, and is connected to Beehive Bend by pipeline (OGJ, Apr. 29, p. 114).

Processing briefs

Ethyl Corp. has reduced the price of TEL antiknock compound effective June 27 to 61 cents per pound for Motor Mix, 62 cents for Motor Plus, and 66.5 cents for Aviation Mix. The new reduction was possible because of a reduction in the price of lead, which could prove temporary.

Esso has completed a new study of its Baltimore fluid coker, using radioactive coke and feedstocks. The tests used Sodium-24, a strong gamma-ray emitter with a half-life of 15 hours. They gave some new data on what takes place inside the reactor of the fluid-coking process.

Development of a new synthetic resin through the polymerization of propylene is claimed by the Montecatini chemical group of Italy. According to reports, the resin can withstand temperatures up to 300° F. and in thicknesses of six-hundredths of a millimeter can carry weight up to 200 lbs. It can be used for electrical insulation, the manufacture of pipe, sanitary equipment, and machinery parts. Foreign interests are reported seeking licenses to manufacture the resin, known as Moplen.

Scientific Design Co., Inc., is now equipped to manufacture catalysts on a commercial scale for processes which the company has developed. A newly completed plant in northern New Jersey will initially make silver catalysts for the ethylene-oxide process.

The new plant will furnish catalyst for the new General Aniline & Film Corp. plant at Linden, N. J., now being erected by SD Plants, Inc. Eventually, catalysts for other processes and custom catalysts will be made.

Esso has completed the first well for underground storage of light fractions at Sorrento, La. It will begin taking butane from the nearby Baton Rouge refinery this week. Four more cavities in the salt dome are being prepared for the 1,100,000-bbl. project. It will handle butane, propane, ethylene, and propylene. Product lines over the 38-mile stretch between the Sorrento dome and the refinery are completed and being tested by Interstate Oil Pipe Line Co.

Universal Oil Products Co. has perfected a new gasoline sweetening inhibitor called U.O.P. No. 5-S. The new additive cuts sweetening time to one-fourth to three-fourths the time required with U.O.P.'s No. 5 inhibitor. The new inhibitor will make it possible to treat many gasolines previously considered impractical to sweeten.

A new natural-gasoline plant 20 miles west of Brownsfield, Tex., was officially opened last week. Owned jointly by Honolulu Oil Corp. and other operators, the plant will process up to 13,000 M.c.f. of gas daily from Prentice field of Yoakum and Terry counties, and from adjoining Cobb and San Andres Ownby fields. Output will be 60,000 gal. of mixed L.P.G. products daily.

During a recent turnaround of its Powerformer-Hydrofiner unit at Baltimore, Esso replaced its Type 1000 Powerformer catalyst with Baker RD-150, the type used in Sinclair-Baker, Kellogg, Socony, and other units. The original catalyst was regenerated and shipped to Esso's Bayway refinery where a new 20,000-bbl. per day Powerformer is going on stream.

Also for Refiners . . .

Control on imports is coming soon—maybe this month (p. 79) . . . Texas Gulf's plan of "minimum control" is one under study in hunting answer to imports problem (p. 80) . . . Texas Railroad Commission reports imports head toward all-time high in July (p. 82) . . . Phillips puts new ammonia plant on stream in Northwest (p. 94) . . . First of four plants in Odessa refining-petrochemical complex nears completion (p. 98) . . . FTC plans a study of the Warren-Gulf merger (p. 99) . . . Ethyl has developed a new gasoline antiknock additive. It's a manganese compound (p. 100) . . . India has selected tentative site for 40,000-bbl. refinery (p. 104).

PLUS THESE TECHNICAL FEATURES: A new technique for estimating pressure drop in heaters (p. 111) . . . Refinery construction index (p. 127) . . . COST-imating (p. 150) . . . Questions on Technology (p. 151) . . . The Foreman's Page (p. 153) . . . PETROdatics (p. 155).

New Ammonia Plant Supplies Northwest

KENNEWICK, Wash.—Agriculture and industry in the Pacific Northwest have a new source of anhydrous ammonia.

Phillips Pacific Chemical Co. has begun full-scale operations at its 200-ton Coulee plant 7 miles southeast of here. The natural gas comes from the San Juan basin of New Mexico and Colorado, through the new Pacific Northwest pipeline.

The new plant is owned jointly by Phillips Petroleum Co., and Pacific Northwest Pipeline Co. Phillips Chemical Co. is the operator. Construction was started in the spring of 1956 by Hydrocarbon Construction Co., under the direction of Fish Engineering Corp.

The plant lies in the tri-Cities area of Pasco, Kennewick, and Richland in southern Washington.

Phillips Chemical operates two other anhydrous ammonia plants: the Cactus plant, near Etter in the Texas Panhandle, and the Adams Terminal plant near Houston. Each has a daily capacity of 525 tons.

Socal tries Rattlesnake Hills:

Washington Wildcat Staked

SAN FRANCISCO.—Standard Oil Co. of California will again try to find oil and gas in the nonproductive State of Washington.

Drilling will begin about July 15 at a wildcat in the Rattlesnake Hills of Benton County in the southeastern part of the state. Location is about 40 miles northwest of Kennewick. Miracle & Wooster Drilling Co. has the contract.

About 100 miles south of the proposed 1 Rattlesnake Hills in the nonproductive State of Oregon, the same company is drilling below 8,700 ft. at the 1 Kirkpatrick, a strat test near Condon.

This is the nearest current drilling operation to the Rattlesnake Hills site. Standard of California intends to move the rig to the new Washington location as soon as the Kirkpatrick is completed.

Company officials pointed out that the new operation is highly speculative and costly, in an area where little is known of the subsurface. They expect it will take about 4 months to drill the test.

Standard of California has been looking for oil in the Pacific Northwest for some time. As early as 1947, the company probed to 11,002 ft. at a test near Seattle. This dry hole is the state's deepest.

The Gray's Harbor area of western Washington has attracted the most attention in the state. Some noncommercial production has been found there between 3,586 and 4,876 ft. in Miocene sands.

Utah Consolidated Oil Co. is now drilling two wells in that area: The 22-1 Swansob is below 4,150 ft., after losing the original hole at 4,333 ft., and the 22-1 Hogan is fishing bailer at 4,918 ft.

In Oregon, General Petroleum Corp. has completed plans to begin its first wildcat in that state. The 1 Long-Bell site is in Douglas County, about 12 miles northeast of Reedsport some 15 miles inland.

Fortune at stake:

Kraemer Heirs File Claims in California

SANTA ANNA, Calif. — A $97,514,437 California oil fortune is at stake in a law suit filed here last week.

Claims for the entire amount were filed against the estates of Samuel P. Kraemer and Gilbert U. Kraemer, whose father, Daniel Kraemer, owned property in Richfield field, Orange County.

The suit charges that an 1883 agreement between Daniel and his brother Jonathan is invalid. That agreement had to do with dividing ranch properties in Orange County.

Under the agreement, Daniel received oil-rich properties in the Placentia area, site of Richfield field.

The suit was filed last week by heirs of Jonathan. Their action, claiming the entire amount, is aimed at invalidating the 1883 agreement. It's the first step in their attempt to gain part of the estate.

Daniel Kraemer's sons, Samuel and Gilbert, won a court decision before they died 6 months ago. At that time, Superior Court upheld their father's 1883 agreement with Jonathan.

Union Subsidiaries Merge

LOS ANGELES.—Two Union Oil Co. of California subsidiaries, Brea Chemicals, Inc., and R. T. Collier Corp., have been merged into one firm to be known as the Collier Carbon & Chemical Corp. with headquarters in Los Angeles.

The Collier Corp. manufactures carbon for chemical and metallurgical processors with the main plant at Santa Clara, Calif. Brea Chemicals operates in the petrochemical field with its main factory at Brea, Calif.

R. T. Collier, president of Collier Corp., will serve as chief executive officer of the new corporation. Homer Reed, former president of Brea Chemicals, will be vice president.

Congrats and $25 to A. V. McIvor, 1255 Wabash St., Pasadena, Calif., for this quip.

"...Looking for the monkey board..."

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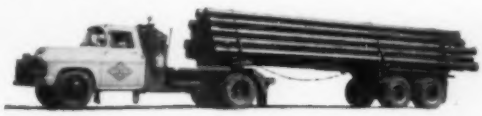

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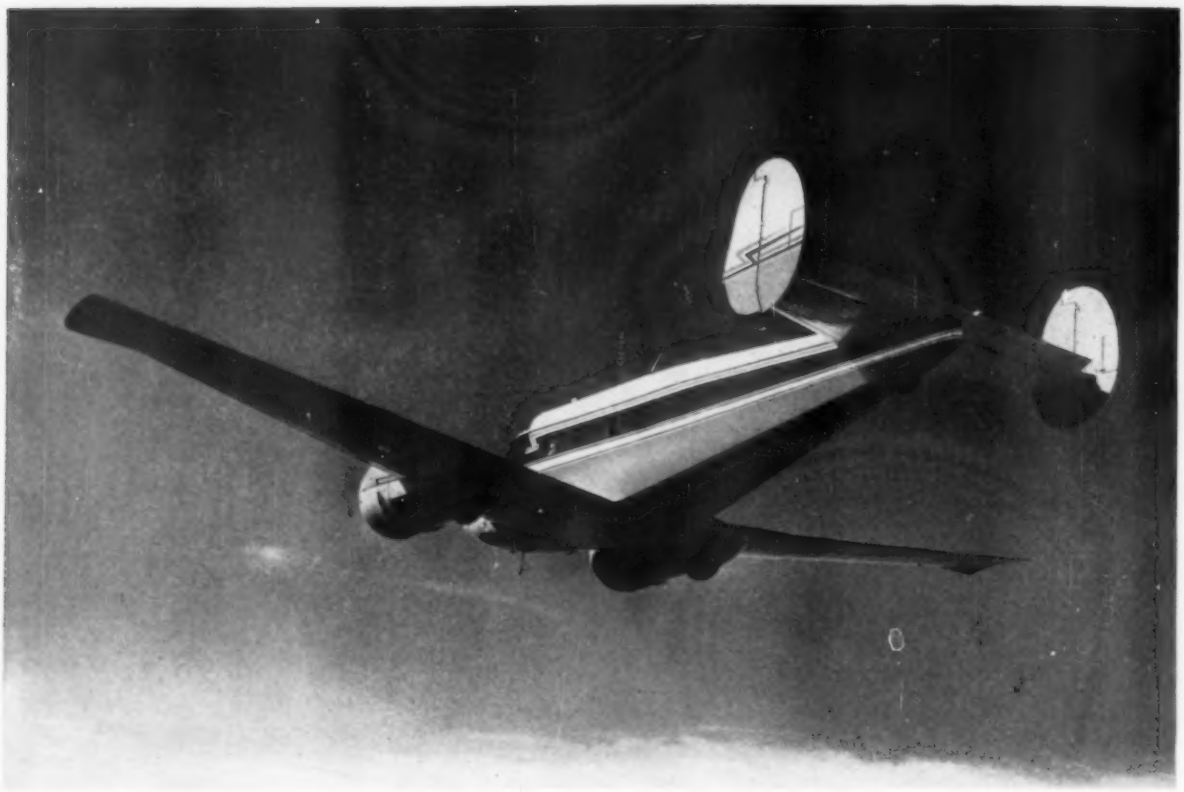

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BEECHCRAFTS ARE THE AIR FLEET OF AMERICAN BUSINESS

Gas Line Contracted

P.G.&E. project includes 138 miles of 34-in. line

SAN FRANCISCO. — Pacific Gas & Electric Co. has awarded contract to Engineers Limited Pipeline Co. for looping the final 138-mile segment of its 502-mile gas-transmission line between Topock, Ariz., and Milpitas, Calif.

In addition to the 138 miles of 34-in. pipe, this final $15-million project calls for an increase from 2,500 hp. to 3,500 hp. at 6 of the 10 compressor units at Topock. Other improvements will be made at compressor stations at Hinkley and Kettleman in California.

When the project is completed by the end of this year, P.G.&E.'s big line will be able to handle 950,000 M.c.f. of natural gas daily and will represent an investment of $128,612,000.

Gas deliveries will be stepped up even more next year with further expansion at Topock and conversions on four compressors at Hinkley. Then the line will have a capacity of 1,025,000 M.c.f. daily.

The 502-mile line is connected to the El Paso Natural Gas Co. system at the California-Arizona border. El Paso supplies P.G.&E. with about two-thirds of its requirements.

The final looping project will begin with a 30-mile segment in San Bernardino County extending easterly from Danby. Another section will stretch 68.8 miles from Oak Creek Pass to Hinkley, and the third segment will cover 39.2 miles between Kettleman and Panoche in the western part of San Joaquin Valley.

Trans-Canada Lets Contracts

CALGARY.—Work will start this month on two sections of the big eastern end of Trans-Canada pipeline. One section is 310 miles of 20-in. from Toronto to Montreal, the eastern terminus of the 2,250-mile line which originates in Alberta. Contracts have just been let for this one.

The other section is 33 miles of 24-in. from Toronto to Niagara, N. Y. This one will tie in at Niagara with Tennessee Gas Transmission Co.'s system. T.G.T. will supply the eastern market until Alberta gas arrives next year.

Contracts on the two projects have been awarded to Oklahoma Pipe Line Constructors, 83 miles of 20 and 24-in.; Dutton-Williams Brothers, Ltd., 120 miles of 20-in.; and Grayco Constructors, Inc., 140 miles of 20-in.

Pipeline briefs

Mountain Fuel Supply Co. has applied to the Utah Public Service Commission for permission to extend its 12-in. natural-gas transmission line from Ogden to Logan and Brigham City, Utah. Cost would be $3,250,000. Service would be started this year. Mountain Fuel owns 118 gas wells in Wyoming, Colorado, and Utah. It has 94 miles of gathering lines, 470 miles of trunk lines, plus distribution and service lines. A 38-mile, 20-in. pipeline to take 58,750,000 cu. ft. daily from Pacific Northwest Pipeline Corp. will increase system capacity to 285,000,000 cu. ft. per day.

Saskatchewan Power Corp. has signed a 20-year contract with Trans-Canada Pipe Lines Ltd., to buy up to 10,000,000 cu. ft. per day. The gas will supply Regina initially and thereafter will provide gas for peak loads on the company's southern system. The cost to Saskatchewan Power will not exceed 24.2 cents per M.c.f. the first 3 years. S.P.C. is going ahead with construction of a compressor station on its system serving Saskatoon, Prince Albert, and North Battleford. It will move 60,000,000 cu. ft. of gas daily. Fish Engineering, Ltd., is designer and Fish Service Corp. is supervising construction.

Cities Service Gas Co. has received Federal Power Commission authority to build 60 miles of gas pipeline costing $1,288,600 in Grant and Alfalfa counties, Oklahoma. The lines include 37 miles of 4-in., 8 miles of 6-in., 4 miles of 8-in., 8 miles of 10-in., and 3 miles of 12-in., tapping new gas supplies of nine producers.

Mississippi River Fuel Corp. plans to expand capacity of its Louisiana-St. Louis gas line by 10,000,000 cu. ft. per day. FPC approval is being sought to add 6,400 hp. to existing compressor stations and 54 miles of 26-in. loops in Louisiana, Missouri, and Arkansas. The project will cost $6,936,000.

Tennessee Gas Transmission Co. is building 33 miles of 6, 8, and 10-in. gas-purchase lateral lines in the vicinity of Southwest Pass below New Orleans. The submarine lines were let to Houston Contracting Co.

Prairie Pipe Manufacturing Co., Ltd., has started production at its $3-million mill at Regina, Sask. The plant is capable of fabricating 75,000 tons of 3½ to 16-in. pipe annually.

Great Lakes Pipe Line Co. has awarded a contract to R. H. Fulton & Co. for 84 miles of 8-in. extension to its products system from the St. Paul area to Eau Clair, Wis. This is part of an over-all expansion program planned by Great Lakes the last half of this year.

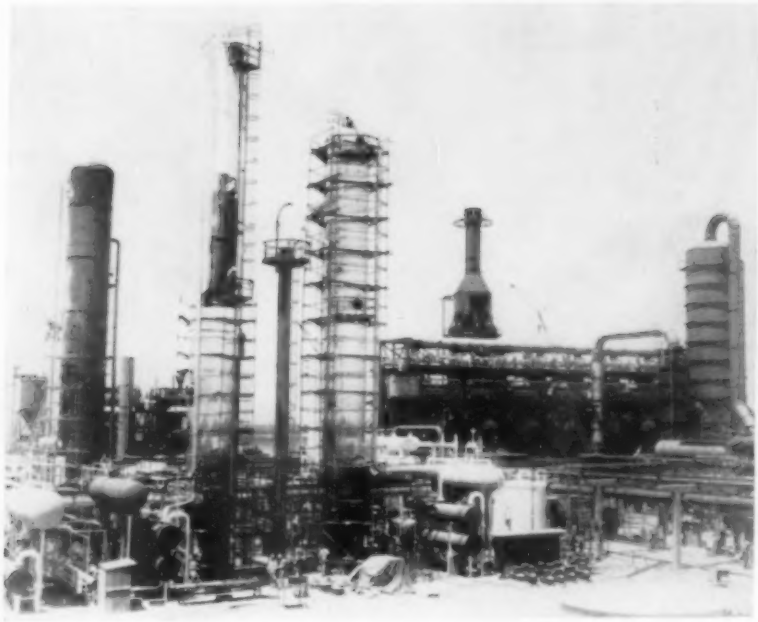
A new pipeline-construction firm, Nelen, Ltd., has been organized in Canada. James P. Neill, head of J. P. Neill & Co., Dallas, is president; C. S. LeNoir, vice president; E. A. Price, vice president; A. D. Kelly, vice president-treasurer; and Edward L. Wilson, secretary. Nelen is engaged as sponsor with Majestic Contractors, Ltd., in a joint venture project to build 84 miles of 30-in. for Northern Ontario Pipe Line Crown Corp. in Ontario. W. B. Williams is field superintendent.

Tennessee Gas Transmission Co. has awarded contracts on two 30-in. sections of its looping program in Kentucky. Bechtel Corp. has 24 miles from Olive Hill to Greenup, Ky., and Oklahoma Pipe Line Constructors has 35 miles, to start this month in the vicinity of Richmond, Ky.

Also for Pipeliners . . .

FPC reversal on its price stand in C.A.T.C. Group's case is now seen as the spark setting off new offshore pipelining and drilling activities (p. 84) . . . Conversion of Texas Eastern's Little Inch from gas to products is expected to change some refining, marketing, and transport patterns in Midwest and East (p. 88) . . . Pacific Gas & Electric has let contract for a 138-mile segment of its Topock-to-Milpitas line (p. 97) . . . A mobile detector does corrosion-checking work on Aramco's Middle East lines (p. 102) . . . French have ordered pipe for their Algerian-Libyan crude line (p. 102) . . . India has cleared the way for a 690-mile crude line opening up Nahorkatiya field (p. 104).

PLUS THESE TECHNICAL FEATURES: How breaks can be eliminated at river crossings (p. 107) . . . Pipeline Patrol tells how Transco doubled microwave network capacity between Houston and Linden, N. J. (p. 161).



Odessa Butadiene shows off new units as . . .

Rubber Complex Takes Shape

ODESSA, Tex.—The first of four plants in a huge $50,000,000 refining-petrochemical complex here is rapidly nearing completion.

All major units of Odessa Butadiene Co.'s $20,000,000 butadiene plant are installed. And the company expects to be in full-scale production by September 1.

The plant will produce up to 50,000 tons of butadiene yearly. The product will go next door to a $12,000,000 copolymer plant which General Tire & Rubber Co. expects to place on stream about the same time. The copolymer plant will produce up to 50,000 tons a year of synthetic rubber.

About the first of January next year, Odessa Styrene Co. will complete a $5,000,000 facility on the same big site to furnish the copolymer plant with its second big raw-material source, styrene.

Styrene capacity will be about 35,000,000 lb. per year. The copolymer plant will use about 25,000,000 lb. of this total. The rest will go to United Carbon Co., part owner of the butadiene and styrene plants.

Shortly thereafter, a neighboring 6,500-bbl. daily refinery will go on stream, taking high-octane raw material—butylene, isobutane, and proylene—from the butadiene and styrene plants to make high-octane gasoline.

The driving force . . . The prime mover and majority owner behind all of these operations except the copolymer plant is the pipeline giant, El Paso Natural Gas Co., operating through its subsidiary, El Paso Natural Gas Products Co.

The products company will own the refinery outright and majority interests in both the butadiene and styrene companies. It owns 75 per cent of the styrene operation, with United Carbon holding the other 25.

United Carbon and Odessa Natural Gasoline Co. own minority interests in the butadiene plant.

Along with this, El Paso Natural Gas Products is plunging into the pipelining business. Slated for completion early this month is a 35-mile 6-in. products line from El Paso Natural's big Midkiff gasoline plant in the Spraberry to the petrochemical site.

The line will handle up to 15,000 bbl. daily of liquids. The contractor, Vaughn & Taylor Construction Co. of Odessa, slowed by heavy rains, was aiming at a July 1 target for completion.

Initially, the line will funnel only butane into the complex as raw material for the butadiene plant. When the styrene unit and refinery are completed, it will begin moving propane and natural gasoline, too.

The propane will feed the styrene plant. The natural gasoline will be used as blending stock at the refinery. General Tire is expected to bring in styrene for rubber manufacture from the Gulf Coast until the Odessa plant is ready.

The products company has a permit from the Texas Railroad Commission to drill three 50,000-bbl. underground storage wells for product storage just south of the complex. Plans are to eventually leach out seven of the 50,000-bbl. cavities.

About the time the butadiene and copolymer plants get into full-scale operation, the company will launch construction of a 6-in. line to take high-octane motor fuels from the Odessa refinery to El Paso. This 240-mile project, including a storage terminal on the El Paso end, would be completed about March 1, 1958—the same time as the refinery.

The line is being designed by Pipeline Engineering Co. of Dallas. Products going through it will be distributed throughout West Texas, New Mexico, and Arizona.

Complex progress . . . Odessa Butadiene's plant has four major process units: a field butane section, a 50,000-ton-yearly dehydrogenation section, an absorption and fractionation section, and a butadiene-recovery section.

Fluor Corp., Ltd., of Los Angeles, designed, engineered, and is constructing the entire butadiene plant.

Fluor already has turned over to Odessa Butadiene the recovery section which employs the C.A.A. (cuprous ammonium acetate) extraction process licensed by Esso Research & Engineering Co. It is concentrating now on final piping and instrument work.

Construction is under way on both the styrene and refinery plants. The styrene unit was designed by Universal Oil Products Co. Fish Engineering Corp. has contract for construction.

Foundations have already been poured for the refinery boilers. Process design too is by U.O.P., and Fish Engineering will engineer the project and procure the major equipment.

Completion of the new Odessa refinery will boost El Paso's refining capacity to about 22,500 bbl. daily—all of it acquired in a little more than 2 years.

The plant will have crude, vacuum, catalytic cracking, gas concentration, Platforming, and HF alkylation units. It will process regular, premium, and aviation gasolines, kerosine, diesel fuel, and fuel oil. High-octane by-products from the butadiene and styrene units will be converted in the refinery into alkylate for gasoline blending.

FTC Books Gulf-Warren Study

Agency claims independent refiners needing L.P.G. and natural gasoline will suffer as result of 1956 merger

WASHINGTON. — Federal Trade Commission investigation of the March 1956 merger of Warren Petroleum Corp. and Gulf Oil Corp. will get under way next fall.

A 2-day hearing was held last week before Examiner J. Earl Cox for the submission of documents to the FTC staff. But Cox said further hearings would be put off until September 9.

Annual reports of the two companies for 1953 and subsequent years and letters and documents regarding the merger agreement were among the papers put into the record.

The FTC issued its complaint against the merger last December 17. It charged Gulf with violating the antimerger law in acquiring Warren.

The FTC charged that the merger "threatens to lessen competition substantially or to tend to create a monopoly," particularly in the production and sale of L.P.G. and natural gasoline.

Before the merger, the complaint alleged, Warren was a dominant marketer of those products and the principal source of supply for independent refiners, dealers, and distributors competing with Gulf and other major integrated companies. Now, the FTC charged, these independents may be forced to look to the major companies for supplies.

What Gulf got . . . The FTC said Gulf had sales of over $1.89 billion and Warren $100 million in 1955. Gulf's assets exceeded $2.16 billion and Warren's $163 million. According to the complaint, Gulf gave common stock valued at $138 million for all Warren common stock.

The FTC alleged that the acquisition of Warren raised Gulf from approximately twelfth to fourth place in the production of natural gasoline.

Its reserves of natural-gas liquids were increased 38 per cent to almost 317 million barrels and it became the second largest possessor of such reserves in the U. S. Gulf also rose from seventh to first place among sellers of L.P.G. to other producers, the FTC claimed.

Lease cancellation studied as . . .

. . . Louisiana Slaps at Importers

BATON ROUGE.—Louisiana may take a slap at oil-importing companies who also hold undeveloped state leases. State officials are looking into the possibility of canceling the leases.

William G. Helis, Jr., chairman of the state mineral board, revealed the move when he appointed a committee to study the feasibility of canceling undeveloped leases granted by the state.

Mayo Isles, a member of the mineral board, was named chairman of the investigating committee. First meeting of the group is set tentatively for this week.

If such a move is taken, it would force the companies either to develop the leases or return them to the state. Any stepped-up development program would fly in the face of cutbacks in production.

The action is aimed specifically against oil-importing companies. It followed an announcement that one major importer, Gulf Oil Corp., had suspended purchases of crude from two fields in Plaquemines Parish. The operator then sought permission to shut in the fields.

J. E. Hill of Richardson & Bass asked permission of the mineral board to shut in Cox Bay and Pointe a la Hache fields after storage is full. The state is one of the big landowners in the two fields.

Temporary markets have been found for about 2,000 bbl. daily of the crude. But shut-in production last week was estimated at about 8,000 bbl. daily.

Conservation Commissioner John B. Hussey, who repeatedly blames "excessive imports" for low production allowables in Louisiana, said he has been informed that some producers in Charenton field also have lost their crude markets.

Warning that further cutbacks in production are not a solution to the present market situation, Hussey reluctantly cut 14,631 bbl. from the state's daily oil allowable. The July allowable of 814,296 bbl. daily is about 185,000 bbl. below the peak during the Suez crisis.

Earlier, Hussey had forecast a reduction of about 30,000 bbl. daily in the July allowable.

—— *Industry* briefs

Sunray Mid-Continent Oil Co. has bought 900 bbl. daily net production in the three-corners area of Arkansas, Louisiana, and Texas, from Arkla Oil Co., Inc., Dallas. The deal involved 16,000 acres of developed and undeveloped leases; interest in 41 wells; and a gasoline plant near Rodessa, La. Arkla Oil was owned by the W. G. Skelly estate in Tulsa. Skelly, founder of Skelly Oil Co., died recently.

Renappi Corp., a Du Pont subsidiary, has agreed to pay more than $2,000,000 for gas properties in Panola and Harrison counties in far-eastern Texas. Sellers are J. C. Trahan, Shreveport, and Fred Whitaker, of Carthage, Tex.

Seven oil and gas producing properties have been purchased in Carancahua and Port Alto fields in Calhoun County, Texas, by Coastal States Gas Producing Co. and Tex Star Oil Co. Net income from the properties is now running about $5,000 a month. Most of the purchase will be financed by production payments.

North Dakota and the Williston basin have a new drilling-depth record. Amerada Petroleum Corp.'s 9-A Unit in the Beaver Lodge field of Williams County is drilling below 14,069 ft. in the Winnipeg. It will go to the granite at about 14,400 ft. The previous record-depth hole was Amerada's 2 Lars Kvam, also in Williams County. The Kvam set a record in 1953 at 14,066 ft., then plugged back to the Madison for completion.

Britalta Petroleums, Ltd., Calgary, has moved into eastern Canada and will start an exploration program immediately. Britalta has acquired all stock of Colonial Petroleums, Ltd., Chatham, Ont. This includes five producing wells in Dawn County, and 8,000 acres of mineral rights in Dunwich, Dawn, Ellis, Enniskillen, Sombra, and Camden-Gore counties. Colonial will be operated as a wholly owned subsidiary of Britalta, with headquarters in Chatham.

Seaboard Oil & Gas Co., Wichita Falls, has moved into the natural-gasoline business with the purchase of a plant in the East Risch field, Jack County, Texas. Seaboard paid Centurion Oil & Gas Co., Dallas, $200,000 for the 18-month-old, skid-mounted installation. Lone Star Gas Co. buys the natural-gas output, and Petrocarbon Chemical Co. of Irving, Tex., buys the casinghead gasoline.

Subsidence Move Near

Richfield urges immediate steps to unitize Wilmington field, separate study started for Tar Zone injection

LONG BEACH, Calif.—First steps finally are being taken toward eventual unitization of the huge Wilmington field. Goal is increased crude recovery and a check on subsidence.

Two devolpments pointed the way last week. They were:

. . . **Richfield Oil Corp.** urged that negotiations begin immediately for unitizing and repressuring Parcel "A" in Fault Block IV of Wilmington field.

. . . **City of Long Beach** and Union Pacific Railroad Co. launched a joint engineering study preliminary to stepping up a water-injection program in the field's Tar Zone.

Time is ripe . . . W. J. Travers, Richfield vice president, in a letter to the Long Beach Board of Harbor Commissioners said that under provisions of a measure adopted recently by the legislature, the first steps can now be taken to unitize the entire field.

Richfield is operator for Long Beach's interests in Parcel "A" while Phillips Petroleum Co. is operator for the privately owned interests there.

By getting together with Phillips, Travers proposes to set up the first of many subunits which will result in eventual unitization of the whole field.

"No fault block should be permitted to lock itself in and become independent of the rest of the field," he said in his proposal to the city. "That might well retard or even prevent the most effective subsidence abatement."

Congress irked . . . Just last week, Long Beach was given sharp notice that Congress is weary of voting funds year after year to keep the Long Beach Naval Shipyard from sinking into the sea.

Many congressional leaders think the shipyard should be abandoned. Loss of the shipyard would be a serious financial blow to Long Beach.

The House armed services committee voted $1.5 million of the Navy's requested $4.6 million for remedial and protective work at the shipyard which is near the center of the subsidence area.

"The Government should not spend any more money until there is full evidence that every possible action is being taken to prevent subsidence," the committee report said.

The report continued ". . . the zeal which has been shown in the extraction of oil must be matched in the immediate future by an equal zeal for preventive and remedial measures to prevent subsidence."

Engineering studies indicate a flood of 1,000,000 bbl. daily will probably be required to halt subsidence (OGJ, Nov. 28, 1955, p. 48).

Additive Revealed

New manganese compound puts extra kick in gasoline

NEW YORK.—Ethyl Corp. has developed a new gasoline antiknock additive which may prove of great importance to refiners.

An organic compound of manganese called AK-33X, it has boosted power output by 20 per cent in full-scale tests conducted by Curtiss-Wright Corp. on its 18-cylinder turbo compound engines.

In these tests it was used to supplement the action of TEL. The new additive is one of the most promising of a new class of chemical compounds being studied in Ethyl's research laboratories, according to E. L. Shea, Ethyl board chairman.

While it is still in the research and development stage, AK-33X is being announced now because of its indicated importance in aviation-gasoline blending. Promised improvements in avgas include faster cruising speeds, larger pay loads, higher altitude flying, and reduced fuel consumption.

Ethyl is now investigating its potential use as a supplementary additive for motor fuel.

Canada Has Important Strike

CALGARY.—One of the year's most significant strikes in western Canada has come in 60 miles north of here. It's the 1-16 Innisfail, a Leduc D3 discovery off the beaten reef track. Location is in southern Alberta south of the Joffre-Bentley area.

The well was brought in by Canadian Oil Companies, Ltd., Security Freehold Petroleums, Ltd., and Calgary & Edmonton Corp., Ltd. It reportedly cut 91 ft. of pay zone and was coring ahead.

On test, the well flowed oil to the surface from 8,512-27 ft. in 35 minutes at the rate of 55 bbl. an hour. Recovery was 700 ft. of oil. Gas flowed to the surface from 8,434-46 ft. in 5 minutes at the rate of 681 M.c.f. per day. Pipe recovery was 630 ft. of gassy oil. From 8,447-72 ft., gas surfaced in 2 minutes at an estimated daily rate of 700 M.c.f. Pipe recovery was 905 ft. of gassy oil and 90 ft. of mud-cut oil.

Cosden Buys Grisham-Hunter

BIG SPRING, Tex.—Cosden Petroleum Corp. has improved its oil-reserves position, following a $7,750,000 deal with Grisham-Hunter Corp., Abilene.

Cosden paid $4,000,000 in cash and $2,000,000 in notes for 5,500,000 bbl. of reserves, including 96 producers and 27 proven locations in Andrews, Ector, and Garza counties, West Texas.

R. L. Tollett, Cosden president, said this pushes the company's total reserves to roughly 30,000,000 bbl.

The company paid out another $1,750,000 for Grisham-Hunter's working capital. The deal represented all Grisham - Hunter's production and working capital.

At the same time, Grisham-Hunter sold oil payments and royalties to an undisclosed investment foundation for $2,250,000. Thus, the company netted $10,000,000 in both sales.

Canadian Crude Demand Up

CALGARY.—United States refiners have requested 106,813 bbl. daily of Alberta crude for July. Total Alberta nominations are 420,494 bbl. daily, an increase of 2,289 bbl. daily over June.

Heaviest U. S. demand is for Shell Oil Co.'s 50,000-bbl. Anacortes, Wash., refinery, which requested 60,600 bbl. daily. Other U. S. nominations were:

General Petroleum Corp., Ferndale, Wash., 28,278 bbl. daily; International Refineries, Inc., Wrenshall, Minn., 9,700; Lake Superior Refining Co., Superior, Wis., 5,160; Bay Refining Corp., Bay City, Mich., 2,500; Dow Chemical Co., Midland, Mich., 325; and Union Oil Co., Cut Bank, Mont., 250.

Imperial Oil, Ltd., continued to lead in demand for Alberta crude. It requested 119,200 bbl. daily. British American Oil Co., Ltd., wants 54,995; Canadian Oil Companies, Ltd., 31,000; and General Petroleums, Ltd., 26,500.

Output Still Rising

U.S., Venezuela drop off, but Middle East rebounds from Suez closure to push April production to a new record

FREE-WORLD crude production in April reached a new high of 15,542,500 bbl. daily despite declines in the United States and Venezuela.

The record was the third in a row. It was achieved by an over-all gain of 243,500 bbl. daily.

Foreign production exceeded 8,000,000 bbl. daily for the first time since the closing of the Suez Canal and Iraq-Mediterranean pipelines last year. The total of 8,001,500 bbl. daily was accounted for by gains of 419,500 bbl. daily.

Countries other than the U. S. had passed the 8,000,000-bbl. daily mark only twice before, in September and October of 1956.

U. S. output declined 176,000 bbl. daily during the month to 7,541,000 bbl. daily. The drop was due to the usual seasonal factors. The heating-oil season was winding up and the summer gasoline season was just beginning, and emergency shipments to Europe were dropping off fast.

Venezuelan output also tapered off with the ending of the winter season. Output of 2,921,300 bbl. daily was down 2,300 bbl. daily. This was the first drop since April 1956 when production declined 78,300 bbl. daily.

Middle East up . . . The Middle East took back another slice of world markets by increasing output to 3,140,000 bbl. daily, a gain of 375,700 bbl. daily. This level was 81.3 per cent of October, the final month of full production.

Each of the "big four" producers shared in the rise. Saudi Arabia gained 133,700 bbl. daily for an average of 918,400 bbl. daily. Kuwait added 114,000 bbl. daily to reach 948,000 bbl. daily. Iraq was up 100,100 bbl. daily to 419,100 bbl. daily, Iran rose 43,000 bbl. daily to 676,000 bbl. daily.

Qatar was the only country in the area to decline. It was off 15,300 bbl. daily to 107,000 bbl. daily. Throughout the crisis, the shaikhdom's production of specialty crude had run closer to normal than its larger exporting nieghbors.

Egypt's production rose to 44,800 bbl. daily, the highest in almost 4 years. This resulted from a rise in production in Belayim field on the Sinai Peninsula to 11,800 bbl. daily (OGJ, June 24, p. 119).

Other areas . . . A number of other comparatively small producing countries set new records.

Trinidad passed the 90,000-bbl. daily mark for the first time with an average of 91,100 bbl. daily. Companies operating on the island increased output 27,000 bbl. daily in the past 2 years with an almost constant succession of small monthly gains.

Other new highs were set in West Germany with 75,200 bbl. daily; Italy 24,800 bbl. daily; and Netherlands, 26,800 bbl. daily.

Cuban production averaged 1,000 bbl. daily, a decline of 150 bbl. daily from March. The decline from March was the result of a continued slump in Jatibonico, which produced 670 bbl. daily.

TREND OVER THE LAST YEAR

	Western Hemisphere less U.S.	Middle East	Total, non-Communist countries
April	3,330.4	3,735.9	7,704.7
May	3,356.5	3,793.9	7,788.1
June	3,519.1	3,713.7	7,871.7
July	3,549.8	3,806.1	7,996.6
August	3,618.2	3,685.8	7,965.6
September	3,637.2	3,721.8	8,019.3
October	3,688.3	3,873.5	8,251.8
November	3,760.8	2,142.8	6,544.2
December	3,915.9	2,428.9	6,598.7
1957—			
January	3,993.9	2,645.7	7,301.7
February	4,040.7	2,855.5	7,561.6
March	4,117.8	2,764.3	7,582.0
April	4,127.5	3,140.0	8,001.5

A World-Wide Look at Crude Production

Daily average in thousands of barrels)

Country—	April 1957	March 1957	April 1956
Western Hemisphere:			
Argentina	99.9	99.9	86.6
Bolivia	9.8	9.8	8.6
Brazil	24.7	24.7	6.7
Canada	523.0	517.0	395.9
Chile	11.0	11.0	9.2
Colombia	127.3	122.9	119.8
Cuba	1.0	1.1	1.6
Ecuador	9.7	9.7	9.5
Mexico	225.0	225.0	254.3
Peru	53.7	53.7	47.9
Trinidad	91.1	89.4	76.6
Venezuela	2,921.3	2,923.6	2,313.1
Total	4,127.5	4,117.8	3,330.4
W. Europe & Africa:			
Algeria	0.4	0.4	0.7
F. Morocco	1.6	•1.6	2.2
Egypt	44.8	34.1	38.2
Austria	63.4	63.4	54.7
France	28.5	28.5	23.1
W. Germany	75.2	72.4	66.5
Italy	24.8	20.1	9.0
Netherlands	26.8	25.6	20.1
Turkey	6.5	6.5	4.9
United King.	1.6	1.6	1.6
Yugoslavia	7.5	7.5	5.4
Total	281.1	261.7	236.4
Middle East:			
Bahrain	30.1	30.0	30.1
Iran*	676.0	633.0	576.0
Iraq†	419.1	319.0	677.8
Israel	1.4	1.3	0.3
Kuwait	948.0	834.0	1,242.2
Neutral Zone	40.0	40.0	29.2
Qatar	107.0	122.3	126.2
Saudi Arabia	918.4	784.7	1,054.1
Total	3,140.0	2,764.3	3,735.9
Other Asia:			
British Borneo	120.0	120.0	118.7
Burma	5.0	5.0	4.7
India	9.2	9.2	7.5
Indonesia	300.0	285.0	251.5
Japan	6.4	6.4	6.8
New Guinea	6.4	6.7	7.0
Pakistan	5.9	5.9	5.8
Total	452.9	438.2	402.0
Free World:			
Foreign	8,001.5	7,582.0	7,704.7
United States	7,541.0	7,717.0	7,146.0
Total	15,542.5	15,299.0	14,850.7
Communist countries in Soviet orbit:			
Romania	220.0	220.0	200.0
Russia	1,885.0	1,860.0	1,550.0
Others	50.0	50.0	50.0
Total	2,155.0	2,130.0	1,800.0
World total	17,697.5	17,429.0	16,650.7

*Includes estimated 4,000 bbl. daily from Naft-i-Shah field not operated by consortium companies.

†Includes estimated 5,000 bbl. daily from Naft Khaneh field, operated by British Petroleum Co.

Figures are from reliable industry reports or official government sources. Data for Communist countries in the Soviet orbit, which includes the European satellites and Red China, are based on competent estimates. Authentic information is not available on month-to-month production in these areas. Estimates also were made for those countries, particularly in Southeast Asia, where complete reports are lacking.

Corrosion found in a hurry as:

Pipeline Spy Goes Modern

A STANDARD "holiday" detector mounted on a mobile unit is taking a lot of the footwork—and time—out of corrosion checking of buried pipelines for Arabian American Oil Co.

Jim Houle, corrosion engineer in the process section of Dhahran oil operations, shown at right adjusting the signal generator, modified a Pearson electronic coating inspector by mounting it on a trailer towed by truck. Ed Peattie, process engineer, is on the trailer testing the detector.

The method reduces both time and effort in locating "holidays," the pipeliner's term for a break in the protective covering on buried line, where corrosion could eventually cause serious leaks.

A two-man team using the mounted version can cover around 6 miles an hour under normal operating conditions. This is ten times as fast as when the team carries the equipment on foot.

When a crew operates on foot, the testers wear special spiked metal plates attached to their shoes as ground contacts. In the mobile version, anchor grounds attached to the rear and front bumpers of the truck substitute for spiked plates.

Aramco corrosion engineers hope to survey the entire length of the company's 270-mile section of Trans-Arabian pipeline system and the 136-mile Safaniya-Ras Tanura line.

So far, Aramco has checked only 18½ miles on the two lines. The detector is used primarily on sections where there is a history of leaks and trouble. The cost of a good-sized pipeline break can run to $500,000.

How it works . . . About 100 breaks in pipeline insulation have been found in sections tested in the past 3 years. Excavations found coating breaks in almost every case where the detector indicated a holiday.

The detector not only reveals bare areas missed in pipeline coating treatment, it also reveals deterioration. Points where coating is too thin to protect the pipe also show up.

The equipment works like this: Current flowing from a signal generator concentrates at holidays. This concentrates current in the ground and results in peaks in the receiver signal.

A loud increase in the headphone signal, combined with a significant needle deviation on the dial, indicates a holiday. Testers can usually roughly determine the size of the exposed area from the strength of the signal.

French Order Pipe

Big crude line will give outlet to Algerian field

ORDERS have been placed with a French firm for 450 miles of 16-in. pipe for a new Algerian-Libyan crude line. The artery would carry oil from the promising Edjele field in southeastern Algeria to a Mediterranean port on the Libyan coast.

Final destination of the line has not been determined. It is reported, however, that it will terminate in Libya, some place between Tripoli and Gabes in Tunisia.

The line is expected to have an initial capacity of 100,000 bbl. daily. It is expected to begin operation with a throughput of considerably less.

Cie. de Recherche et d'Exploration de Petrole au Sahara, which discovered and is developing Edjele field, will construct the line.

The decision to terminate the line in Libya means that it will be considerably shorter than an all-Algerian line proposed earlier.

In addition to being shorter, the proposed line, possibly, could carry oil from prospective fields east of the Algerian-Libyan border. Esso Standard Oil Co. of Libya has a concession immediately east of Edjele.

Announcement of the line did not mention any planned connection with production developed at Hassi Messaoud, almost 400 miles northwest of Edjele. This field, also lacking an outlet, is closer to the proposed ocean-side terminus of the line from Edjele than it is to the Algerian Mediterranean coast.

The French earlier were talking of connecting Hassi Messaoud with a small-diameter line or lines to railheads at Biskra or Laghouat. But economics favor an all-pipeline route against a pipeline-railroad combination. So it is believed likely that the proposed line from Edjele also will tie in with Hassi Messaoud.

Thailand May Get Refinery

Thailand's first oil refinery will be built if negotiations now under way are successfully concluded.

The refinery, of 15,000 bbl. per day capacity, is planned for Siracha, 80 miles east of Bangkok. It would cost $22,500,000.

Summit Industrial Corp., of New York, is a partner in the negotiations. Others include Chinese Petroleum Corp. of Formosa, a Nationalist China Government enterprise, and one or more French banks. Foster Wheeler Corp. of New York, has been con-

sulted on the design and construction.

Products of the refinery would include 82-octane gasoline, fuel oil, jet fuel, and diesel fuel. It would operate on Middle East crude, probably from Kuwait. The entire output is expected to be consumed locally.

The Thai Government is reported to have given its approval, with an eye to taking over the refinery as a state-operated agency some time in the future.

Paraguay Opened

Grants first concession along border of Bolivia

PARAGUAY'S first oil concession has been granted to International Products Corp. of New York, according to C. A. Koons, International president.

The concession covers 750,000 acres in the Chaco region adjacent to the Bolivian border. It is good for 4 years, with an option to extend.

The area is close to the former Glenn McCarthy development in Bolivia, where some production has been found, and near the Bolivia Gulf concession where drilling is scheduled to get under way soon.

International plans to test the area on a farmout basis with U. S. oil companies.

Under Paraguayan law, the concession holder can take up to 50 per cent of the exploration area if reserves are proved up. Initial taxes are 10 centavos per hectare for the first 4 years and 15 for the second.

Exploitation taxes range from 15 to 60 centavos per hectare. The government's royalty would be 10 per cent on production up to 5,000 bbl. per day, 12 per cent on 5,000 to 10,000, and 15 per cent above 10,000.

Creole Plans Crude Line

CREOLE PETROLEUM Corp. will build a 90-mile, 30-in. pipeline in eastern Venezuela to provide an outlet for the viscous crudes of Temblador field.

The line will extend from El Pilon via Maturin to Caripito. Contracts for design, engineering, and construction were let to Pipe Line Engineering Co. and Oklahoma Pipe Line Constructors, both of Dallas. The firms will operate as a joint venture. This will be a turnkey job. Creole will furnish material and equipment for the pipeline and Oklahoma will have its own construction equipment.

Pipe will be delivered the last quarter of 1957. Construction will start the first of next year. The line will be completed in about 90 days.

World briefs

British Petroleum Co., Ltd., has ordered 26 tankers in a $224,000,000 expansion program that will increase the size of its fleet by more than one-third.

The new tankers, ordered from British yards by B.P. Tanker Co., will total 1,150,000 dwt. Seven of the vessels will be of 65,000 tons; nine, 50,000 tons; five, 34,500 tons; and five, 15,500 tons. Two of the 34,500-ton ships may be increased to 50,000 tons.

B.P.'s present fleet includes 147 ocean-going tankers of more than 2,000,000 tons. The new orders are in addition to building programs announced last year by B.P.

Bolivia has set its deadline back to July 22 for receiving bids on 108,200 acres just north of the Argentine border and adjacent to the Glenn McCarthy development. The acreage straddles the Yacuiba anticline, which reportedly has yielded oil on the Argentine side of the border (OGJ, June 10, p. 78). McCarthy has found oil and gas on his concession.

Chile's products pipeline which has been hanging fire for several years is apparently firmed up. Pipe has been ordered for delivery in September. Construction is expected to start at that time.

The 10-in. line, to move kerosine and diesel oil, will run 75 miles from Concon to Santiago. Williams Brothers, which designed the line, will build it. The operating company will be Nacional de Oleoductos, Ltda., formed by Cia. Petroleos de Chile (COPEC), Empresa Nacional de Petroleo (ENAP), and Esso Standard Oil Co. (Chile) Sac. (OGJ, Apr. 29, p. 119). Copec will furnish 720 million pesos and Enap and Esso each will furnish 290 million pesos of the total cost. Operation is expected to start early in 1958.

A $56-million petrochemical project is planned for West Germany by British Petroleum Co., Ltd., and Farbenfabriken Bayer of Lever Kusen. B.P. becomes a partner through its West German affiliate, B.P. Benein und Petroleum G.m.b.H.

The plant, to be located in Dormegen, near Cologne, will draw raw materials from B.P.'s 80,000-bbl. refinery now going up in Cologne. The refinery will go on stream in 1960 and supply about 300,000 tons of feed stocks a year. The petrochemicals to be manufactured were termed organic, semifinished products.

Second successful well at Afam, Nigeria, is reported to have been completed by the Shell-British Petroleum combine. Afam is 20 miles east of Port Harcourt. This is the third well drilled in the area. Further development is planned. In light of the success encountered, a pipeline to Port Harcourt is being considered. A line already is under construction from the first Nigerian discovery at Oloibiri, 65 miles west of Port Harcourt.

Iran's law prohibiting the government from negotiating with foreign interests for the development of oil has been annulled. The government is authorized to develop the nation's resources under a bill passed in June providing the agreement with outside interests is approved by the Majlis, the Iranian national assembly.

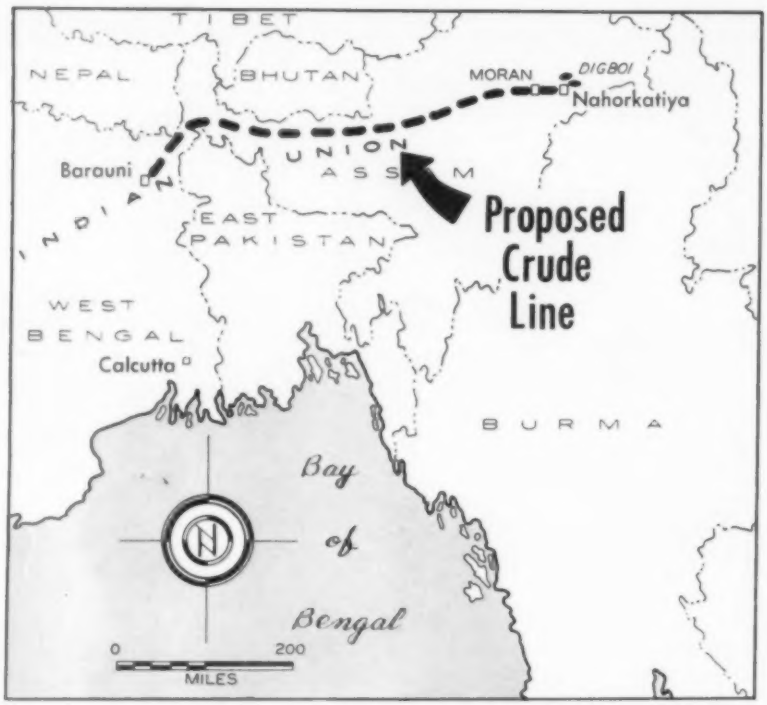
Mexico's most important recent discovery, El Hallazgo, near Vera Cruz is rated by Pemex as the country's most important oil discovery since the expropriation of foreign interests in 1938. It is located south of the Rio Tecolutla in the State of Vera Cruz and extends southeast of Papantla to the Gulf of Mexico. It is near the refineries at Atzcapotzalco, Salamanca, Tampico, and Tuxpan.

Lobitos Oilfields, Ltd., has placed a new 800-bbl. U.O.P. Platforming unit on stream at its Cheshire, England, refinery. The unit, built by Procon (Great Britain), Ltd., is designed to produce an 85 to 90 R.O.N. clear production from Kuwait naphtha or a 90 to 95 R.O.N. clear blending component from mixed Peruvian naphthas.

The project included a prefractionator to separate naphtha from full-range gasoline or prepare a 127°-302° F. naphtha for Platforming feed from Peruvian stock. Other new equipment includes amine recycle gas scrubbing facilities with water wash and glycol drying for use when processing a Kuwait charge.

Most units of Japan's new 30,000-bbl. refinery at Tokuyama are now on stream. Latest additions to the Idemitsu Kosan Co., Ltd., plant are four units licensed by Universal Oil Products Co.

The new facilities include a 3,000-bbl. Platforming unit, a fluid catalytic cracker, a Unifining unit, and a Unisol unit. U.O.P. also designed the plant's crude-distillation unit.



India Field Looks Up

Outlet for huge Nahorkatiya moves big step closer as government eyes compromise site for disputed refinery

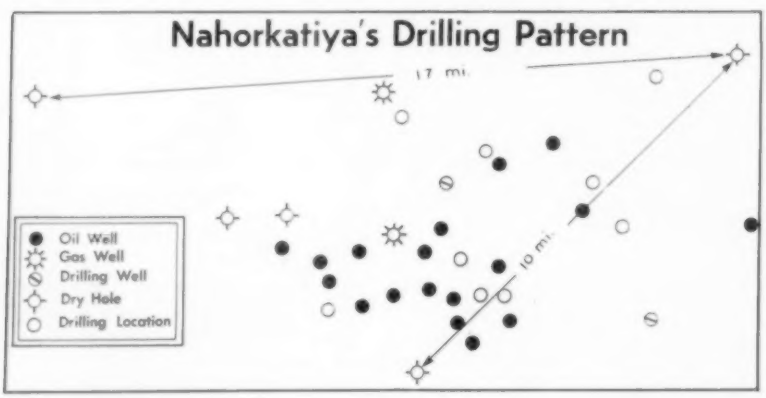
INDIA HAS MADE a key move that could clear the way for a 600-mile crude pipeline and a 40,000-bbl. daily refinery to handle output from huge Nahorkatiya field.

The government has tentatively decided to locate the refinery at Barauni, in Bihar Province, 250 miles northwest of Calcutta. The question of a location for the plant has kept Nahorkatiya shut in for more than a year.

Assam Oil Co. has pushed development drilling in Nahorkatiya, pending a settlement of other points holding up production. The map, below, while not to exact scale, indicates the general pattern of field development.

The Burmah Oil Co., Ltd., subsidiary has drilled 25 wells. Eighteen are commercial producers, two are gas wells, and five are dry holes. Two more wells are drilling. Production comes from about 10,000 ft.

Assam Oil's senior geologist has estimated that the field can produce 50,000 bbl. of oil and 45,000 M.c.f. of gas daily for 20 years. This would indicate proved reserves in excess of 365,000,000 bbl., not including proved production from the nearby Hugrijan or Moran areas.



With this kind of field needing only an outlet, here is what could quickly follow a final decision by the government:

. . . Agreement on a rupee company to own a refinery. The government will own two-thirds interest and Assam Oil one-third. Ownership of Nahorkatiya production is the reverse, with the company owning two-thirds and the government one-third.

The chief drawback to agreement has been the plant location. Assam Oil says economics dictate building the refinery at Calcutta. The government, yielding to political pressure from Assam, has held out for a plant near Nahorkatiya where markets are lacking.

Barauni was the third site studied by a government commission. The location was called potentially more profitable than any site in Assam, and it may be a compromise choice.

. . . A 600-mile pipeline to carry crude to Barauni. The town, however, is not far from probable route of a line terminating at Calcutta. A 250-mile extension to Calcutta could be added later.

The government reportedly has a survey under way for an 850-mile, 20-in. pipeline from Nahorkatiya to Calcutta. Sources in India say the line would be designed to carry from 50,000 bbl. to 80,000 bbl. daily. Presumably, the survey could plan a route through Barauni. It is being made by a United States firm and is expected to be completed this year.

. . . Intensified exploration by the government in Assam. India is carrying on some exploration on its own, in addition to concession grants to private companies.

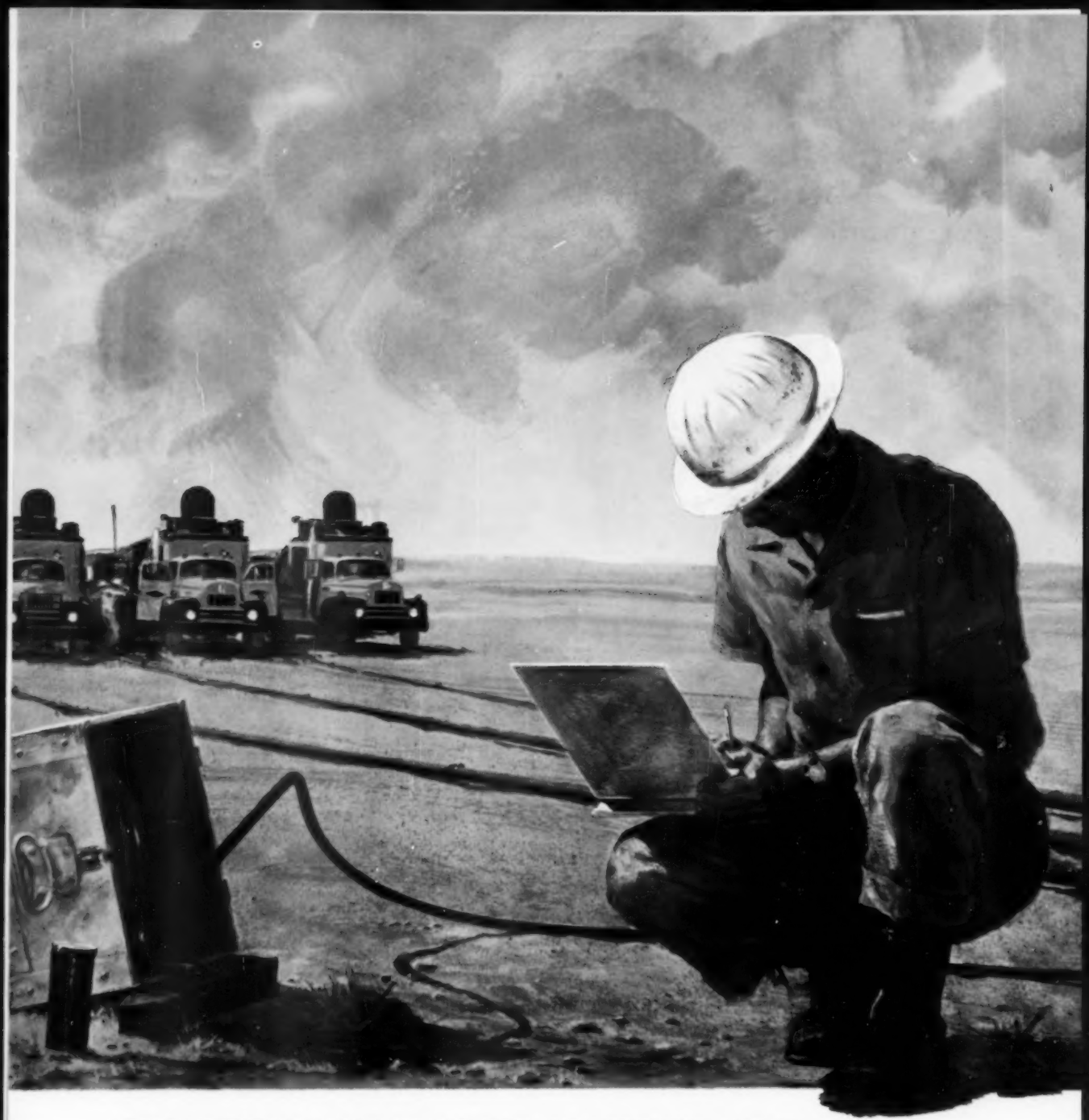
The country's oil and natural-gas commission has decided to begin immediately a seismic survey in Assam on areas not held under license by Assam Oil.

Rig Heads for Turkey

A drilling rig shipped from Houston last week will be used by Tidewater Oil Co., Atlantic Refining Co., and Seaboard Oil Co. to explore their concession in Turkey.

A spokesman for Tidewater, operator for the group, said drilling is expected to start by September. At least two tests are planned on the concession in eastern Turkey which the three companies obtained last year.

In addition to a drilling rig, the shipment includes tractors, road-building machinery, portable houses, pipe, and a several months' supply of food. The cargo is valued at more than $2,500,000.



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The Dowell man in the field, with his intimate knowledge of local field problems, is often the spark for our research. You see, at Dowell the development of new techniques, products, and services is not the job of laboratory scientists alone. It's everyone's job. Practical research in the field is going on continuously, hand in hand with the research programs in our laboratories.

Many of our well treatment services and products have stemmed from the continuous search by Dowell field personnel for a *better* way of doing your job.

Laboratory research is important—that's why we maintain some of the best equipped, best staffed laboratories in the oil industry. But that alone is not enough. To provide you with new and improved services and products, Dowell will continue to combine ideas from our chemical, physical and mechanical labs *and* from the man in the field. Dowell Incorporated, Tulsa 1, Oklahoma.

Services for the oil industry

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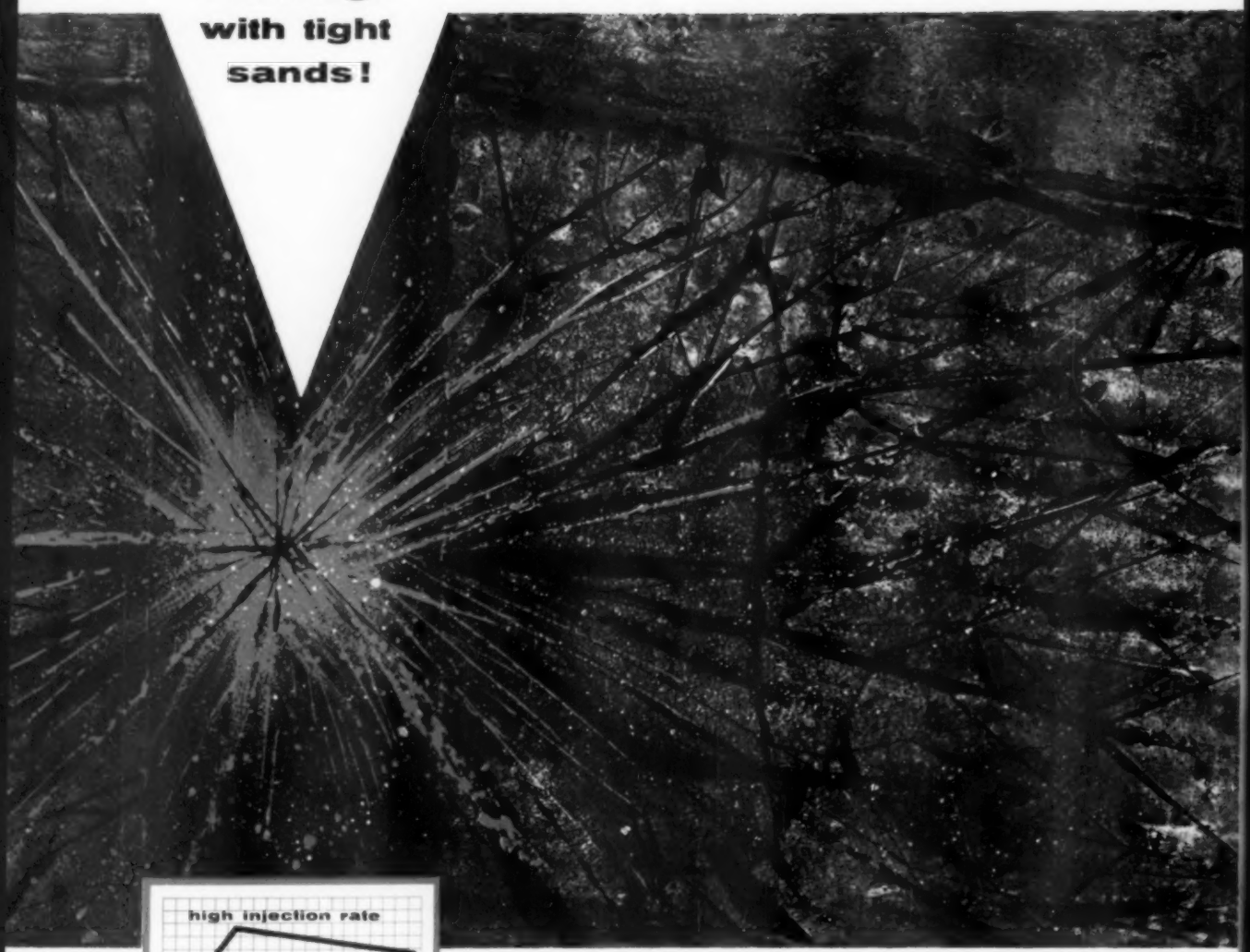
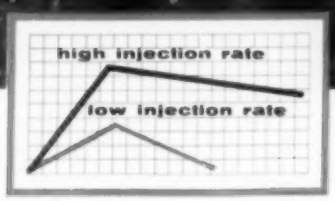
Get tough with tight sands!





High injection rates have shown greater production and slower decline.

In most things, gentleness is good and proper.

But not so with some oil and gas reservoirs. To make them *give*, often calls for a "get tough" policy.

Dowell knows how to get tough with tight sands, and has the equipment needed to do it. Exclusive with Dowell is the new high-injection-rate "Frac Team": 1) the mighty Allison Pumper with power to spare, 2) the Remote Panel for safer operation, and 3) the Dowell Blender for precise control of sand and fluid mixing.

More and more, operators are finding that the harder you hit some formations with frac fluid, the greater the production is increased. Two to ten barrel-per-minute rates often provide little more than temporary stimulation. On the other hand, thirty to fifty bpm injection rates into the same formation often establish high and lasting production potentials. Also, with high injection rates, there is less danger of sand screen-outs.

Got a tight sand problem? Dowell will get after it with the experience and equipment they pioneered in high-injection-rate fracturing. Dowell Incorporated, Tulsa 1, Oklahoma.

Services for the oil industry

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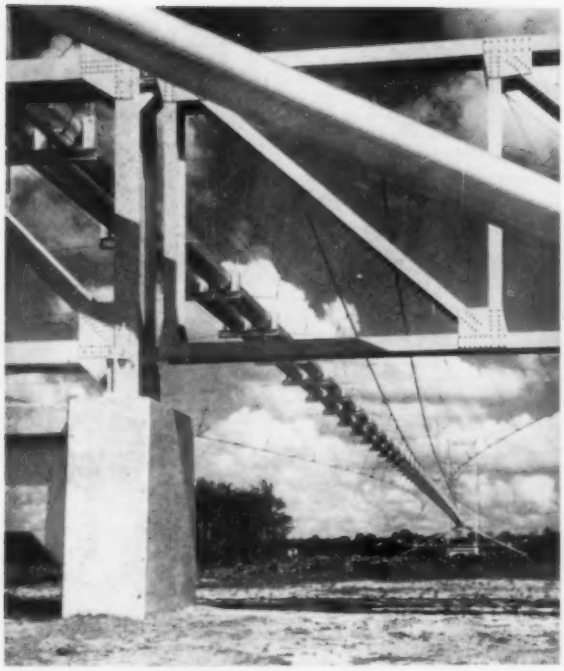


OVER OR UNDER? A suspension bridge is one way of crossing a river. But high cost confines it generally to deep gorges with stable banks. Submarine lines are generally used. But the same exhaustive studies of river habits must be made for both. Fig. 1.

There's a lot of engineering involved in

Getting a Pipeline Across a River

Here begins a three-part article pointing out what we've learned about pipeline river crossing and why they seldom break any more

By Leo M. Odom

PART 1

BREAKS in pipelines at river crossings were quite common up until a few years ago. The steadily increasing sizes, pressures, lengths, and investments in pipelines have made it mandatory that the river crossings be constructed on a more permanent basis.

For this reason pipeline river crossings are now receiving about the same degree of care in investigation, design, and construction as is given to railroad and highway crossings. No breaks in river crossings of large lines have come to the attention of the author in several years.

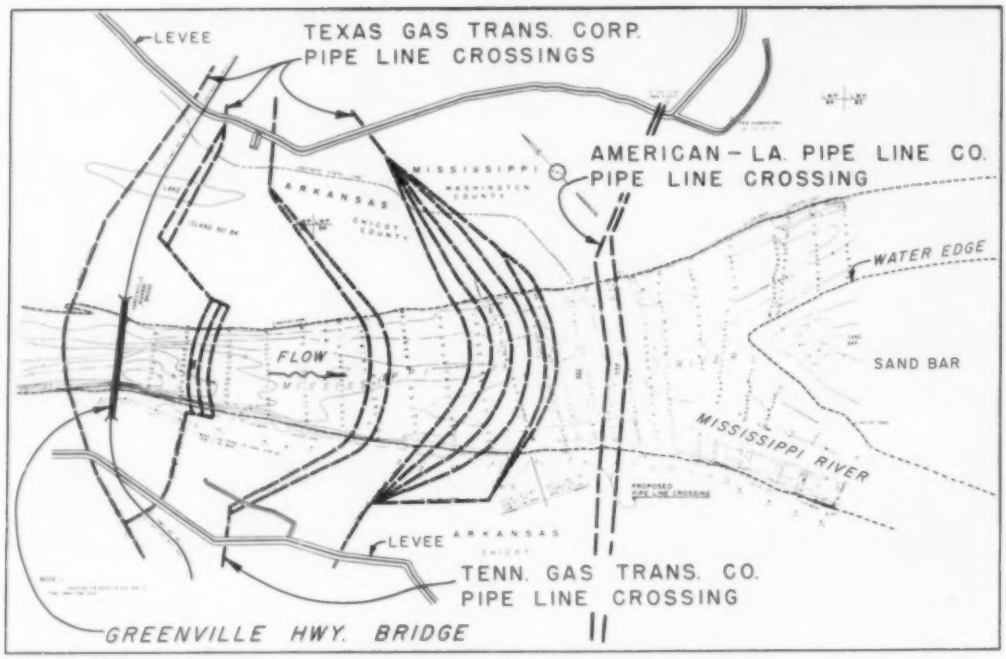
Pipeline river crossings are sometimes made by bridges, but underwater crossings are by far the most common largely because of lower first cost and maintenance.

In the design of underwater crossings the primary considerations peculiar to the problem are the counterbalancing of buoyancy, protection from external damage, and provision of strength to resist structural failure. The type of river and its geological, hydrological, and historical characteristics must be taken into account in the selection of the site, the design of the crossing, and the determination of the best working season. The design of a bridge involves somewhat the same investigations as the design of an underwater crossing plus certain additional considerations due to its exposure.

The specifications and testing required should be complete enough to guarantee that the crossing will be adequate and capable of serving its function for the contemplated life of the project. However, the methods and details of construction should be largely left to the discretion of the contractor. Construction methods and equipment are constantly changing as the problems involved become better understood and new ideas develop. Overzealousness by engineers in specifying how the job shall be done could result in the blocking of one of the greatest sources of progress in pipelining, i.e., the ingenuity of the contractors.

Pipelines carrying gas, crude oil, and petroleum products under high pressure are built of welded steel pipe and this type of pipeline is the one specifically referred to in this paper. The problems involved in stream crossings of lower-pressure water lines, which are usually built of cast-iron pipe, are similar to a degree but

Author is with Pyburn & Odom, consulting engineers, Baton Rouge, La. Paper presented at A.S.C.E. meeting in Jackson, Miss.



PIPELINE ALLEY. There's a reason for the popularity of this Mississippi River crossing site. It's one of the rare stable reaches to be found. Fig. 2.

have special facets of their own.

The successful crossing of a river requires thorough study of the way rivers behave and why, and particularly how the river in question acts and will act in the future. It is, therefore, felt necessary to go into the fundamentals of river engineering at some length.

Characteristics of rivers . . . The word "river" covers a large variety of streams and their characteristics vary widely. Very few general statements can be made that would be applicable to all rivers. Each river must, therefore, be considered as a separate problem. Some rivers have rocky beds; some are subject to sudden severe floods; some meander in silty plains; some have acid or alkaline water; depths may vary from 2 or 3 ft. to 200 ft., and widths from 200 or 300 ft. to over a mile.

A study of the hydrology is necessary for the determination of rainfall, runoff, and stream flow. The geology of the watershed and of the river reveals significant data concerning erosion and future action. Hydraulics, soil mechanics, and potamology are important fields of investigation in the solution of river problems. Of most use are the gage records and maps of previous, as well as up-to-date, surveys and previous and up-to-date cross-sections and profiles. These are needed for considerable distances up and downstream from the site under consideration.

Types of Crossings

Bridges . . . There are basically two types of crossings: bridges and underwater crossings. Bridges aren't used nearly so often as other types. A great deal of study has been devoted to the design of bridges for pipelines to minimize the size of members and the cost of the piers.

Nevertheless they are generally much more expensive, are more costly to maintain than properly built underwater lines, and are liable to damage from high winds and flying objects. They are also fully as vulnerable to damage from caving banks as underwater lines. Their economical use would therefore seem to be confined to deep gorges with stable banks. A good example of a pipeline bridge is shown at left on Fig. 1.

Underwater crossings . . . In the construction of underwater crossings several ideas about the proper layout have been followed. Crossings are sometimes made by laying the pipes across the river on top of the bed and banks but more frequently by entrenching them into the bed and banks to give them protection.

When the lines are laid on the bottom without entrenchment, they are usually heavily weighted and the crossing is made by use of a number of small lines which are connected to the land line through headers.

Formerly, it was commonly accepted practice to lay all lines with bows either upstream or downstream between banks. Pipes laid in this manner were sometimes placed in trenches and sometimes on the bottom without entrenchment.

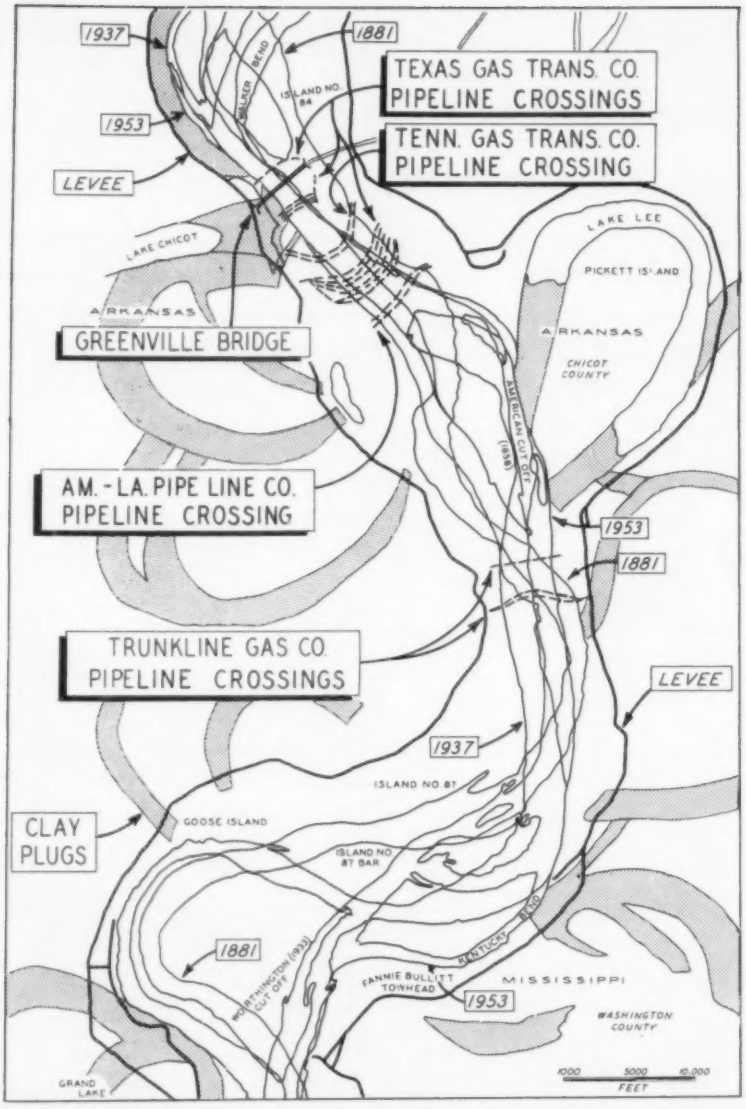
Multiple small lines . . . One company has used multiple small pipe laid in "sinusoidal" curves across the bottom of the Mississippi River at its crossings of that stream.

The advantages claimed for curves in the plan of the crossing seem to be questionable. But there is no doubt as to the advantage of the greater flexibility of small pipe in conforming to bed changes provided extra length is available. A number of smaller pipes in a crossing makes complete loss of service by rupture of the pipe less likely, and a cheaper crossing can be constructed without entrenchment.

The crossing of the Mississippi River near Natchez by Interstate Natural Gas Corp. consisting of seven 10-in. lines was constructed in 1926 and only one line has been lost. It was broken by the dredging anchor of an LST boat in 1944.

These lines are very heavily weighted. The river at this location is considered unusually stable. Nevertheless, it has been found necessary to keep a constant watch on the crossing and to "feed" a good many feet of pipe into the river on each line to prevent breaks due to bed and bank changes even though they have been comparatively small.

Double main lines . . . The crossing



MEANDERING MISSISSIPPI. Low-water bank-line locations are plotted for 21 miles of river. Shaded areas are abandoned channel fillings. Fig. 3.

of a river by straight continuation of the land line pipe without decrease in size provides obvious advantages although it is usually somewhat more expensive in first cost. In a river of the type and size of the Mississippi such a crossing must be entrenched below probable scour lines in the bed and into the banks a sufficient distance to provide against exposure by caving during the economic life of the project.

In large, important crossings an auxiliary line of the same size as the main line is always provided as an insurance factor. One of the main advantages of using pipe of main-line size in the crossing is that scrapers can be carried through the lines without having traps at each side of the crossing. When the design of such a crossing is based on adequate investigation and careful consideration of the factors involved, it is fully as safe as any other type.

In making all river crossings it is of primary importance to locate them in a part of the river that is as stable as possible. The Mississippi River is notable for its meandering tendencies and stable reaches are the exception. One of these is found in the vicinity of the Greenville bridge. This reach of the river has therefore become a veritable "pipeline alley," as can be appreciated from Fig. 2.

Here can be seen pipes laid straight across the river as well as pipes bowed both up and downstream. Tennessee Gas Transmission Co. has several pipes on the bridge itself, which was bought for the purpose. It was found to be cheaper to buy the existing toll highway bridge and make it free to highway traffic than to build a new bridge for pipelines only. (Fig. 5.)

"Basic problem in the selection of the site as well as in the design of the crossing of an alluvial river lies in understanding what the river is doing at the time."

Selection of the Site

Rivers not only differ among themselves but the characteristics of the same river vary greatly from place to place along its length. It is conceivably possible to construct a durable river crossing at any given location. But from a practical standpoint it is necessary to exercise great care in selecting the site for the crossing in order to save time and money.

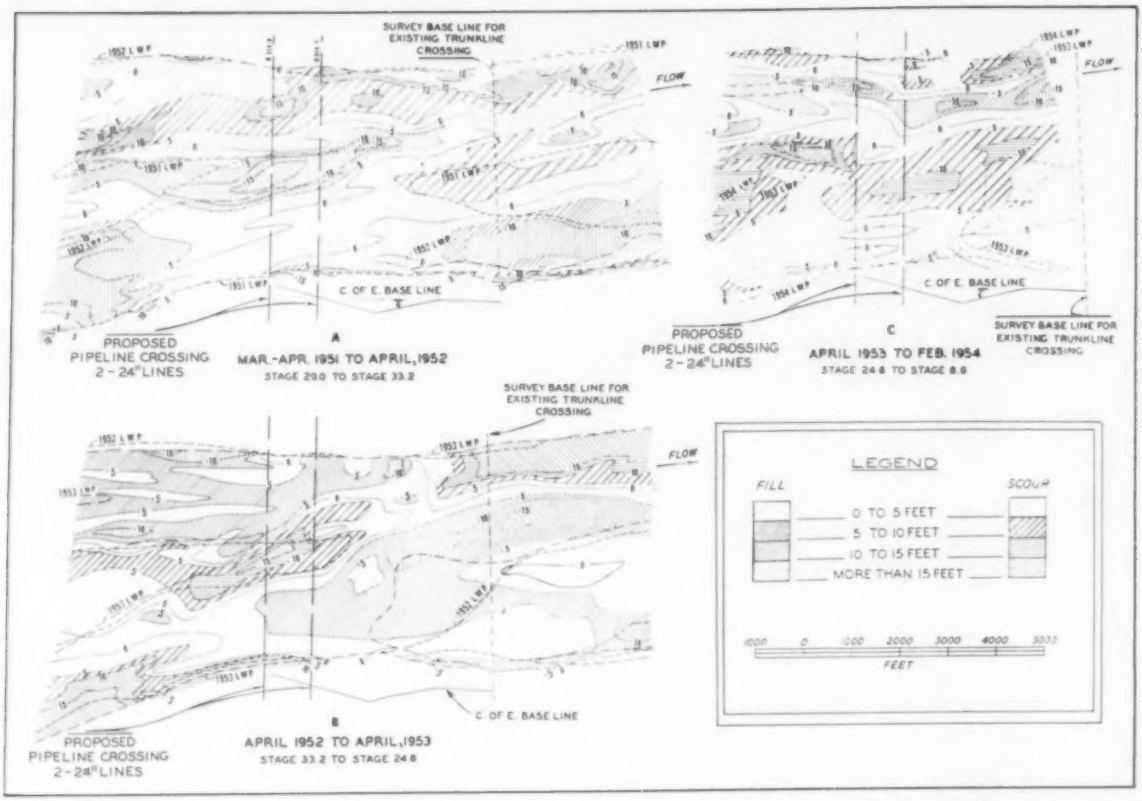
The over-all alignment of the pipeline must, of course, be taken into consideration in the selection of the site. But when rivers the size and character of the Mississippi are to crossed, large changes in alignment are frequently necessary to avoid reaches with extreme instability.

Basic problem and data . . . The basic problem in the selection of the site as well as in the design of the crossing of an alluvial river lies in understanding what the river is doing at the time. By study of this action and of available data you must be able to predict within relatively narrow limits what it will do within a given future period.

In making the study for selection of the site it is first necessary to compile the history, geology, and hydrology of the stretch of river within which the crossing could be feasibly and economically made. Basic data are usually obtainable from the records of the U. S. Army Engineers, and other federal and state agencies.

A study of this information makes possible a fairly close approximation of the best location. It is then necessary to make an accurate up-to-date survey of the river, noting caving banks, sand bars, etc., to arrive at the best location within the selected reach.

A map prepared for use in selecting a pipeline crossing of the Mississippi River is shown on Fig. 3. The bank line locations in accordance with



BED-CHANGE STUDIES are shown in vicinity of proposed pipeline crossings. These behavior trends influence the decision on the crossing site. Fig. 4.

surveys made by the U. S. Mississippi River Commission in 1881-82, 1913, 1939, and 1953 are plotted for 21 miles of river. Levee lines and significant data from geological reports are also shown.

Thalweg profiles for these years for this reach were also plotted on another drawing. On the basis of this study several locations were selected for more detailed investigation. This detailed investigation included bed-change studies, as shown graphically in Fig. 4. These indicate the direction of action of the river and whether the changes indicate that there may be a general trend in progress or whether the changes are more or less cyclic.

Comparative cross-sections were also plotted at these locations. Profiles for underwater crossings based on a life of 20 years were laid out at the tentatively chosen sites and cost estimates were computed. The crossing site was selected on the basis of these studies. A detailed survey was then made of the selected site to be sure that no important changes had occurred after the last available survey and to provide information for final layout and construction drawings.

TOLL BRIDGE across Mississippi was bought by Tennessee Gas Transmission Co. and made free to traffic. This turned out to be cheaper than building a new bridge for pipelines alone. Fig. 5.

How to estimate

PRESSURE DROP IN HEATERS

A family of enthalpy lines is superimposed on the phase (pressure-temperature) diagram of the stock being vaporized. This makes it possible to run a continuous heat balance on the heater while making a graphical integration to evaluate the pressure vs. length curve.

By Paul Buthod

ONE OF THE more difficult process-design problems is that of estimating the pressure drop through a furnace handling a petroleum stock with large amount of vaporization. The basic method has been to divide the heater coil into sections for a trial-and-error solution. A Fanning or Darcy friction factor (such as applies for single-phase flow) is chosen from experience.

Dittus and Hildebrand[1] and more recently Maker[2] have published methods for making this calculation. Maker's published method[2] carries out a graphical integration on a **p** vs. **H** chart. Maker uses a Fanning friction factor of 0.025. He does a good job of weighting this friction factor with return-bend loss. But the "simple" friction factor may not always be applicable for the case of two-phase flow through a heater coil. Therefore, one of the published correlations for two-phase flow has been incorporated into the method presented here. (The problem of friction factor is discussed in more detail toward the close of this article.)

The present method involves:

1. Solution for pressure drop by graphical integration. To aid the calculation, a family of enthalpy lines is superimposed on the pressure-temperature (flash vaporization) diagram of the petroleum stock.

2. The Lockhart-Martinelli[3] correlation is used for estimation of friction factor. A Lockhart-Martinelli parameter is incorporated in the integral equation for evaluation of coil length. Return bends are included as equivalent length of line.

3. A check is made for possible existence of critical flow in the transfer line. If critical flow exists a larger line must be used to avoid shock waves and unstable fractionator operation.

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The present method involves some trial and error but is believed to be more direct and faster. The thermal path through the transfer line is assumed to be essentially adiabatic; ordinarily there will be only a small enthalpy change due to change in velocity. The pressure drop through the transfer line therefore can be calculated along a constant **H** line, unless there are great changes in velocity.

A family of enthalpy lines is constructed on the pressure-temperature diagram by: (1) determining the enthalpy for the zero vaporization line on this diagram, and (2) making trial-and-error computations at some given pressure—say 14.7 psia. The latter involves assuming a per cent vaporized checking velocity, solving for the enthalpy of the liquid-vapor mixture assumed, then adjusting back until the assumed value checks with the calculated. With constant enthalpy lines established, it is then possible to make the integration back through the heater. This, too, is a trial-and-error procedure. A line pressure is assumed and density, etc., calculated until a match is obtained between the assumed and calculated pressures. Beyond the transfer line, the thermal path through the heater is no longer adiabatic; the ρ vs. **p** and other plots are adjusted accordingly.

1. Other Methods

A brief review of the methods of Dittus and Hildebrand[1] and of Maker[2] are given.

Dittus and Hildebrand . . . This method involves construction of a family of dp/dL lines (at a given pressure these lines are approximately linear with respect to L). This method assumes a constant heat absorption rate for a given section of heater coil. Such assumption may be made for tubes absorbing heat by radiation. Pressure drop is calculated for small segments of the coil starting at the outlet and working back to the inlet. A pressure drop is assumed for a small segment. From this an average temperature is assumed with the aid of the flash vaporization curve. Then per cent vapor is calculated from heat contents and average H of the segment. Pressure drop can then be calculated, and the procedure repeated until the assumed pressure drop matches the calculated.

In sum, in the Dittus-Hildebrand method, the enthalpy of the fluid, H, is taken proportional to the coil length, L, and dp/dH substituted for dp/dL using an equation from which dp/dH can be determined as a function of H. This equation includes terms for friction drop and velocity head. The Dittus-Hildebrand method may be speeded up by constructing: (1) a plot of H vs. tube number, (2) a chart (linear) of total enthalpy of fluid vs. temperature for lines of different per cents vaporized, and (3) a crossplot of (2) by plotting temperatures vs. per cent vaporized for lines of average H corresponding to the heater segments to be calculated.

Maker . . . Dittus and Hildebrand stated that velocity head effect is not important relative to the friction pressure drop. But Maker notes that in the case where a residuum is being vaporized under vacuum, operating velocities may be very high and special consideration must be given to velocity head effect as well as to critical-flow-rate limits.

In Maker's method lines of constant per cent vaporized are plotted on a **p** vs. **H** grid with the aid of E.F.V. data and a Cox chart. On this **p** vs. **H** grid, lines of constant specific volume are superimposed. A graphical integration can then be carried out.

Maker also tackles the case where velocity pressure is not small relative to total pressure drop. For this case he modifies the equation for dp/dH to include the velocity term. But the modified equation remains in a form which permits graphical integration.

Nomenclature

A = cross-sectional area for flow, sq. ft.
D = inside pipe diameter, ft.
f = friction factor, dimensionless
g = conversion factor, 32.2 (lb. mass) ft./(lb. force) (sec.^{2})
G = mass velocity, w/A, lb./sec.-sq. ft.
H = enthalpy, B.t.u./lb.
J = mechanical equivalent of heat, 778 ft.-lb./B.t.u.
L = equivalent length of flow pipe, ft.
p = pressure, lb./sq. in.
P = pressure, lb./sq. ft.
T = temperature, °F.
u = linear velocity, ft./sec.
V = specific volume, cu. ft./lb.
W = weight rate of flow, lb./sec.
x = weight fraction of vapor in the two-phase mixture
Z = elevation above datum, ft.
$\Delta P/\Delta L$ = pressure gradient in single-phase flow, lb./(sq. ft.) (ft.)
$(\Delta P/\Delta L)_{TP}$ = pressure gradient in two-phase flow, lb./(sq. ft.) (ft.)
Φ = parameter from Lockhart and Martinelli[5]
X = parameter from Lockhart and Martinelli
ρ = density, 1/V, lb./cu. ft.
μ = viscosity, lb./ft.-sec.

Subscripts

L = liquid phase
G = vapor phase
TP = two phase

2. This Method

Still other approaches have recently been made to the general problem of pressure drop for flow of flashing liquids[3,4] which incorporate the data of Lockhart and Martinelli[5] for two-phase flow. The method given here uses the mechanical-energy balance, a heat balance, the phase diagram of the oil, and the correlation for two-phase flow of Lockhart and Martinelli.[5]

The differential form of the mechanical energy equation is as follows:

$$144\ dp/\rho + u\ du/g + dz + (\Delta p/\Delta L)\ (dL/\rho) = 0 \qquad (1)$$

For single-phase flow the $(\Delta p/\Delta L)$ of the last term represents the frictional effect and is expressed by the Fanning friction factor equation

$$\frac{\Delta P}{\Delta L} = \frac{2\ f\ u^2\ \rho}{Dg} \qquad (2)$$

Neglecting the elevation term which is small, utilizing the equation of continuity $W/A = G = u\rho = u/V$ and multiplying Equation 1 by the density, ρ, the following form is obtained:

$$144\ dp + \frac{G^2}{g}\ dV + \frac{2\ f\ G^2}{Dg\rho}\ dL = 0 \qquad (3)$$

This may be rewritten in the following integral form:

$$\int (D\rho/2f)\ d\,(144\ gp/G^2 + V) = -L \qquad (3a)$$

The method of Lockhart and Martinelli[5] expresses two-phase flow as a function of the pressure drop if the liquid (or vapor) is flowing in the same line at the same weight rate as the liquid (or vapor) alone. The multiplier Φ_L^2 (Φ_V^2) is presented as a function of the dimensionless term X.

$$\left(\frac{\Delta P}{\Delta L}\right)_{TP} = \Phi_L^2 \left(\frac{\Delta P}{\Delta L}\right)_L = \Phi_L^2 \times \frac{2\ f\ (1-x)^2\ G^2}{D\ g\ \rho_L} \qquad (4)$$

$$X = (W_L/W_G)^{0.9}\ (\rho_G/\rho_L)^{0.5} \times (\mu_L/\mu_G)^{0.1} \qquad (5)$$

for turbulent flow in both phases.

$$f = \frac{0.046}{[(1-x)\ DG/\mu_L]^{0.2}} \qquad (6)$$

for turbulent flow.

Substituting Equation 4 into Equation 1 the following form is obtained:

$$144\ dp + G^2/g\ dV + \frac{2\ f\ \Phi_L^2\ (1-x)^2\ G^2}{D\ g\ \rho_L}\ dL = 0 \qquad (7)$$

This may be rewritten in the integral form:

$$\int \frac{D\ \rho_L}{2\ f\ \Phi_L^2\ (1-x)^2}\ d\left(\frac{144\ g}{G^2}\ p + V\right) = -L \qquad (7a)$$

Equation 3a or 7a must be solved graphically.

Procedure

In conducting the calculation, the correlation of Edmister and Pollock[6] may be employed to construct the phase diagram. The properties of the equilibrium liquid and vapor obtained in flash vaporization of a feed stock have been described in other correlations.[7,9] Enthalpy values may be read from a chart such as that compiled by Shell Development Co.[8]

The procedure in calculating pressure drop is to start in the vaporizing or flash section of the fractionator and work backward through the transfer line to the furnace, then back through the heater to the coil inlet. The transfer line is assumed to operate adiabatically and the enthalpy at any point in the line can be calculated by the energy-balance equation:

$$H_T - H_L = (u_L^2 - u_T^2)/2gJ \qquad (8)$$

Since the velocity in the tower is negligible,

$$H_T - H_L = u_L^2/2gJ \qquad (8a)$$

The difference between enthalpy in the fractionator and line enthalpy is seldom large and usually may be neglected. In such a case the path through the transfer line is at constant enthalpy.

Where there is a large amount of vaporization, critical flow may exist. In single-phase vapor flow this is the condition when sonic velocity is reached. This is the maximum velocity attainable in a flow line of constant cross-section and occurs at the point of discharge. In Equations 3a or 7a it occurs at the point where there is no change of length with change in pressure or $dL/dp = 0$.

Referring to Equation 1, neglecting

the elevation term and dividing by dp,

$$144/\rho + (u/g)\,(du/dp)$$

$$+ (\Delta p/\Delta L)\,(1/\rho)\,(dL/dp) = 0 \quad (1a)$$

Since $\Delta p/\Delta L$ cannot be infinite for any finite flow rate and ρ is not zero, then for critical flow where $dL/dp = 0$ the third term becomes zero. Substituting the equation of continuity and rearranging, Equation 1a becomes, for critical flow,

$$G^2/144\,g = -\,dp/dV \quad (9)$$

If pressure is plotted against specific volume, the point where the slope is $-\,G^2/144\,g$ represents the pressure at which critical flow exists. If this is higher than fractionator pressure then critical flow will exist in the transfer line at the point of discharge into the tower and a shock wave will occur in the tower due to the sudden release in pressure. If this phenomenon occurs the pressure drop should be calculated back from the point of critical flow rather than from tower pressure. This condition makes for noisy, unstable column operation and may be avoided by selecting the proper size of transfer line.

The rate of heat input in the radiant section of a heater is usually assumed to be substantially constant throughout the length of the line. If this is so, the enthalpy of the oil will decrease uniformly with length as we move backward through the heater. Equation 7a is still used, but in a stepwise fashion, adjusting the enthalpy, the per cent vapor, and the specific volume according to the heat transferred in the calculated length.

As the point of zero vaporization is approached, X becomes very large, Φ_L approaches 1.0, $1-x$ approaches 1.0, ρ approaches ρ_L, and Equations 3a and 7a become identical. Since the remainder of the coil is in liquid flow it is then a simple matter to solve for the pressure at the coil inlet.

Summary of Method-Steps

The procedure can be summarized in these steps:

1. Obtain T. B. P. and Gravity-Mid Per Cent curves for the stock.

2. Determine E.F.V. and phase (pressure-temperature) diagram using Edmister-Pollock correlation[6] where laboratory data are lacking. On the phase diagram locate the point representing conditions in flash section of fractionator.

3. Plot A.P.I. gravity-yield of distillate and bottoms. (This can be obtained with the aid of the Edmister charts.[7]) Also plot volume per cent vs. weight per cent vaporized, and molecular weight of vapor vs. per cent vaporized.

4. Construct a curve on the phase diagram representing the path through the transfer line. One point on this curve will be that representing conditions in the fractionator. If enthalpy is not constant check ΔH in the transfer line by the equation

$$H_T - H_L = u_L^2/2gJ$$

and plot the curve according to this equation. (Enthalpy data may be obtained from a chart such as that of Shell Development Co.[8]) The point on the curve corresponding to zero vaporization may be read directly from the enthalpy chart. The other points on this curve are determined by trial and error.

5. In the same manner draw constant enthalpy lines at approximately 25 B.t.u./lb. increments over the range of about 150 B.t.u./lb.

6. Plot a curve of V vs. p. Get volumes from phase diagram.

7. Check whether critical flow exists by determining the point where $-\,G^2/144\,g$ is the slope of the V vs. p curve. Another way of determining this point is to plot the L vs. p curve and note if a negative value of L is obtained. If critical flow exists, line size should be adjusted to eliminate this.

8. Plot

$$\left(\frac{D\,\rho_L}{2\Phi_L^2 f(1-x)^2}\right) \text{ vs. } \left(\frac{144\,gp}{G^2} + V\right)$$

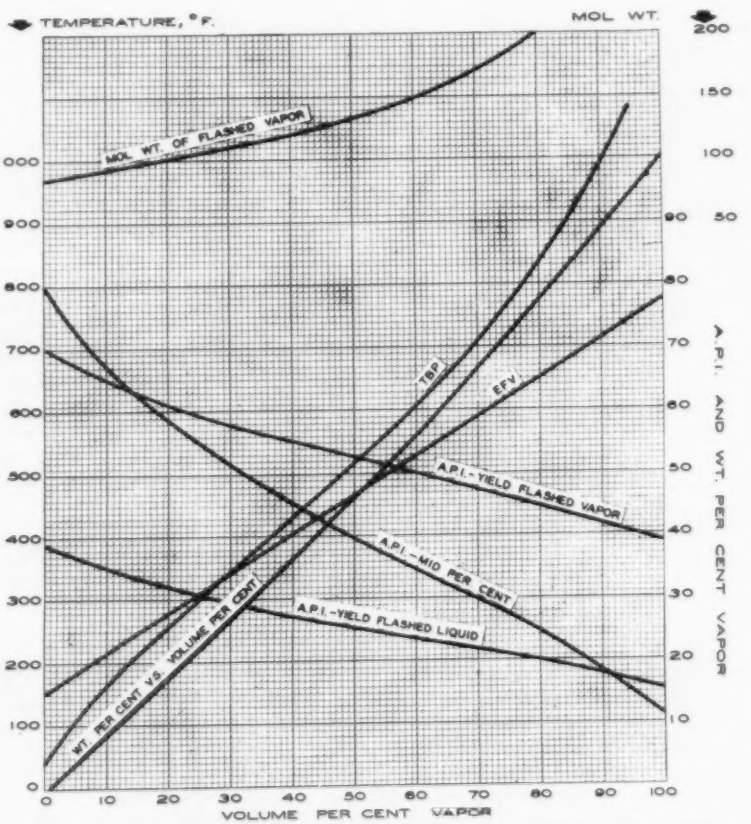
and evaluate the integral in the equation,

$$\int \frac{D\,\rho_L}{2\,f\,\Phi_L^2\,(1-x)^2}\,d\left(\frac{144\,g\,p}{G^2} + V\right) = -L \quad (7a)$$

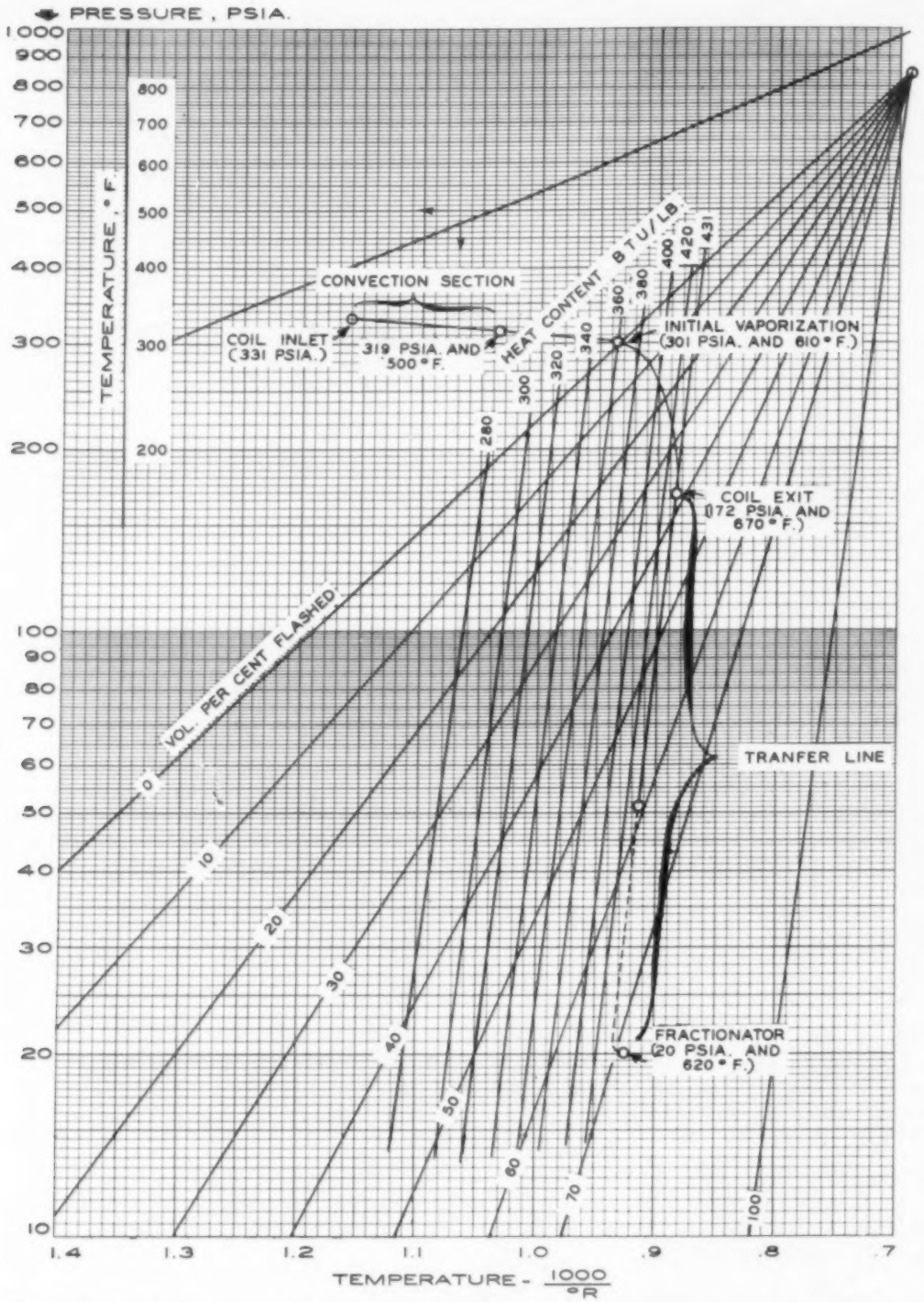
The pressure at the entrance to the transfer line is determined from the abscissa of the plot when the integral (area under the curve) is equal to the length of the transfer line. If critical flow occurs (as determined in Step 7) the lower pressure limit in this equation is the pressure at critical flow.

9. Find the heat input per foot of equivalent length (B.t.u./lb.-ft. equivalent length).

10. Assume a pressure in radiant section of furnace. Solve the equation given above in Step 8 for length L, adjust enthalpy by heat input per foot of equivalent length as found in Step 9, read again the per cent vaporized from the phase diagram and recalcu-



EVALUATION CURVES for the 38.8° A.P.I. crude used in the example. Fig. 1.



THE PHASE DIAGRAM for the crude in the example is constructed using the flash curve from Fig. 1 and the focal point coordinants given. Fig. 2.

late the density. Make adjustments in this procedure until density and calculated length check. The density vs. pressure curve will have a break at the point representing heater exit.

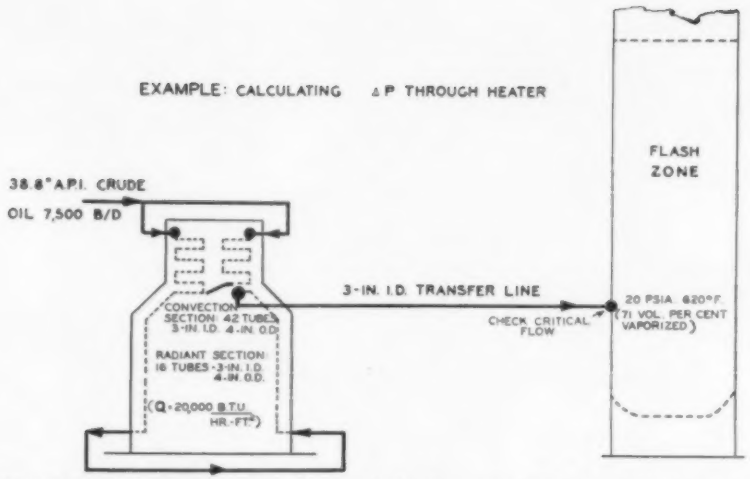
Continue stepwise at increasing pressures until the point of zero vaporization is reached.

11. Liquid-phase pressure drop may be determined by standard formulas or by Equation 3a which reduces to

$$L = D g \rho \Delta P / 2 f G^2$$

3. Example

A 38.8° A.P.I. crude oil is to be heated in a pipe still at the rate of 7,500 bbl. per day from 400° F. to a temperature high enough to produce 71 volume per cent vaporization in the fractionator at 20 psia. The evaluation curves for the crude are shown in Fig. 1. The characterization factor for the crude and its fractions is 12.0, and the focal point


EXAMPLE: CALCULATING ΔP THROUGH HEATER
38.8° A.P.I. CRUDE
OIL 7,500 B/D
CONVECTION SECTION 42 TUBES 3-IN. I.D. 4-IN. O.D.
RADIANT SECTION 16 TUBES-3-IN. I.D. 4-IN. O.D.
(Q = 20,000 B.T.U. / HR.-FT²)
3-IN. I.D. TRANSFER LINE
CHECK CRITICAL FLOW
FLASH ZONE
20 PSIA. 620° F. (71 VOL. PER CENT VAPORIZED)

PRESSURE DROP through this heater is calculated as example of one which shows the use of this new method.

coordinates are 848 psia. at 987° F.

A 3-in. i.d. transfer line runs from the furnace outlet to the fractionator. The radiant section consists of sixteen 4-in. o.d., 3-in. i.d. tubes (40-ft. heated length) which absorb heat at the average rate of 20,000 B.t.u./hr./sq. ft. of outside surface. The unheated section of the tube and the return bend has an equivalent length of 15 ft.

The convention section is composed of 42 of the same tubes and bends as in the radiant. These tubes are connected in two parallel banks of 21 tubes each.

Estimate the pressure required at the furnace inlet.

1. Preliminary Data—Phase Diagram

The physical properties of the crude are shown in Fig. 1. Using the flash curve from Fig. 1 and the focal point coordinates given, the phase diagram is drawn (Fig. 2). The conversion of temperatures to reciprocals is shown in Table 1. In Fig. 2 the reciprocal scale is plotted from right to left in order to make the phase diagram read in the right direction. An auxiliary scale of temperature vs. reciprocal temperature is plotted above the phase envelope as a convenience in reading the chart.

TABLE 1—DATA FOR PLOTTING PHASE DIAGRAM

Vol. per cent flashed:	Temp., °F.	Temp., °R.	1,000 / °R.
0	154	614	1.63
10	216	676	1.48
20	278	738	1.35
30	340	800	1.25
40	402	862	1.16
50	464	924	1.08
60	526	988	1.01
70	588	1,054	0.952
100	774	1,234	0.81
Focal point	987	1,447	0.69

2. Calculating Enthalpy Lines

The condition in the tower is 20 psia. and 620° F. at which condition 71 volume per cent or 68 weight per cent is vaporized. The enthalpy in the tower is calculated with the aid of an enthalpy chart[8] as follows:

$$0.68 \times 466 + 0.32 \times 355$$

$$= 431 \text{ B.t.u./lb.}$$

Except for the kinetic energy which is usually small, the enthalpy will remain constant throughout the transfer line. By choosing a pressure and estimating a per cent vaporized and corresponding temperature from the phase diagram an enthalpy can be calculated. Adjustments must be made in the assumed per cent vaporized until the enthalpy of the mixture is 431. A check on the velocity should be made to find the magnitude of the kinetic energy term, and the required enthalpy reduced by that amount. Table 2 gives results of a number of such calculations. Each line in the table is the result of a trial-and-error calculation, except the last one for zero vaporization which may be read directly from the enthalpy chart.

Transfer-line enthalpy . . . An example of the method used in constructing Table 2 is given for the 50-psia. point.

Assume 50 volume per cent vaporized

Read A temperature of 634° F. from Fig. 2

Read 500 weight per cent vaporized from Fig. 1

Check enthalpy of mixture

$$H = 0.55 \times 477 + 0.45 \times 365 = 426$$

The oil flow rate is $7{,}500 \times 42/24 \times 6.918 = 91{,}000$ lb./hr.

The mass velocity is

$$\frac{91{,}000 \times 144}{(3)^2 \times 0.785 \times 3{,}600} = 516 \text{ lb./sec.-sq. ft.}$$

The liquid specific volume is $1/62.4 \times 0.71 = 0.0226$ cu. ft./lb.

The vapor specific volume is $10.7 \times 1{,}094/146 \times 50 = 1.6$ cu. ft./lb.

The volume of 1 lb. of vapor-liquid mixture is $1.6 \times 0.55 + 0.0226 \times 0.45 = 0.89$ cu. ft./lb.

The density of the vapor-liquid mixture is $1/0.89 = 1.13$ lb./cu. ft.

The linear velocity is $516 \times 0.89 = 459$ ft./sec.

The kinetic energy is $(459)^2/64.4 \times 778 = 4.2$ B.t.u./lb.

The enthalpy in the line is $431 - 4.2 = 426.8$ or 427 B.t.u./lb.

The calculated enthalpy is 426 which is considered a close enough check. If the check had been bad, a new per cent vaporized would have

TABLE 2—ENTHALPY AND DENSITIES IN THE TRANSFER LINE

Pressure, psia.	Volume per cent vapor	Weight per cent vapor	Temp., °F.	Specific volume	Density, lb./cu. ft.	Velocity, ft./sec.	Kinetic energy	Required enthalpy	Calculated enthalpy
20	71	68	620	2.26	0.443	1,165	27.2	404	
30	65	61	615	1.54	0.65	795	12.6	418	
40	62	58	620	1.13	0.89	582	6.8	424	420
50	59	55	634	0.89	1.13	459	4.2	427	426
60	57	53	637	0.742	1.35	382	2.92	428	427
80	54	50	645	0.55	1.82	284	1.62	429.4	430
100	50	45.6	655	0.43	2.33	222	0.99	430	430
150	42	38	660	0.266	3.75	137	0.37	430.6	430
200	33	29.5	673	0.165	6.06	85	0.146	431	433
400	0	0	693	.....	.....	.....	.....	431	431

been tried and the operation repeated until the two volumes of enthalpy coincided.

The data from Table 2 are plotted in Fig. 2 as a line representing the path from the tower condition upward to the point of zero vaporization. This line is nearly straight; it departs from linearity in the region where kinetic energy is significant. The region below 50 psia. is shown as a dashed line because the velocity exceeds the critical flow value as will be shown later.

In addition to the line for the enthalpy in the transfer line which has been developed in Table 2, a number of other constant-enthalpy lines must also be drawn. These are approximately parallel and are spaced by reading temperatures at increments of 20 B.t.u./lb. on the zero vaporization line. The direction of these lines should be checked by a trial-and-error calculation to establish a point at lower pressure. These lines have been calculated and plotted on Fig. 2.

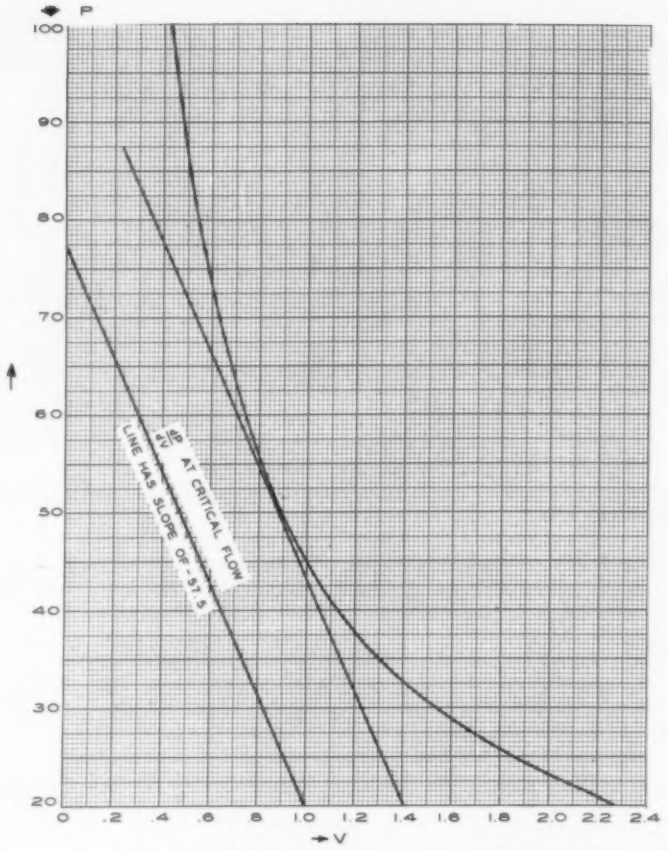
3. Check Critical Flow

Before calculating pressure drop it will be necessary to check whether critical flow exists at the end of the transfer line. Referring to the equation, $G^2/g = -dp/dV$, the maximum slope of the p vs. V curve is $-G^2/144\,g$, where maximum velocity occurs.

Pressure and specific-volume data from Table 2 are plotted in Fig. 3. The slope dp/dV at critical flow is

$$\frac{dp}{dV} = -\frac{G^2}{144\,g} = -\frac{(516)^2}{(144 \times 32.2)} = -57.5$$

A straight line of −57.5 slope is shown on Fig. 3 and when it is shifted over to the p-V curve it is found to hit a point of tangency at about 51 psia. This indicates that critical flow will occur at 51 psia. which condition will exist in the line at a point adjacent to the fractionator. **Note:** In an actual design the transfer line should be changed to a larger size to eliminate this critical-flow condition; but for purposes of illustration the problem will be continued with the small-diameter line.



PRESSURE AND SPECIFIC-VOLUME DATA are obtained from Table 2. Slope of the dP/dV line at critical flow is shifted to the p-V curve and the point of tangency found. Fig. 3.

4. Calculating Pressure Drop

Table 3 shows the evaluation of data for the graphical integration of Equation 7a. The terms X and Φ_L were determined in accordance with the method of Lockhart and Martinelli. Fig. 4 is a plot of the term

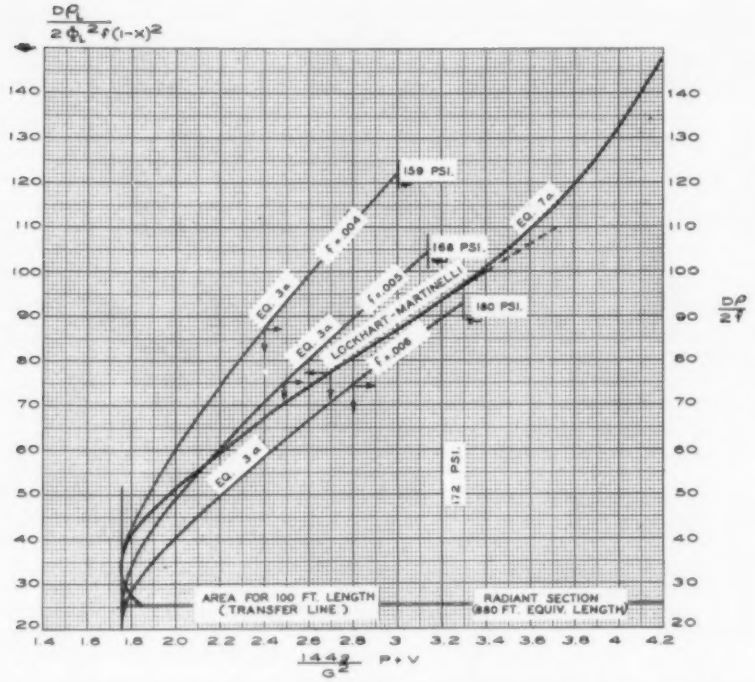
$$\frac{D\,\rho_L}{2\,f\,\Phi_L^2(1-x)^2} \text{ versus } \frac{144g\,p}{G^2} + V.$$

The area under the curve represents the length of the line and was stopped

TABLE 3—DATA FOR PRESSURE DROP IN TRANSFER LINE*

p (psia.)—	40	50	60	70	80	90	100	120	140	160	180	200
$(144g/G^2)\,p$	0.695	0.87	1.042	1.22	1.39	1.57	1.74	2.09	2.44	2.78	3.12	3.48
V	1.13	0.89	0.742	0.63	0.55	0.49	0.43	0.353	0.294	0.246	0.206	0.165
$(144g/G^2)\,p + V$	1.83	1.76	1.784	1.85	1.94	2.06	2.17	2.43	2.73	3.026	3.326	3.645
x	0.58	0.55	0.53	0.51	0.50	0.47	0.456	0.42	0.39	0.355	0.325	0.305
1 − x	0.42	0.45	0.47	0.49	0.50	0.53	0.544	0.58	0.61	0.645	0.675	0.695
ρ_L	45	45	44.5	44.5	44.5	44.5	43.5	43	41.7	41.5	41.3	41
ρ_G	0.52	0.62	0.73	0.833	0.93	1.01	1.10	1.27	1.45	1.56	1.68	1.84
$(\mu_L/\mu_G)^{0.1}$	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
$[(1-x)/x]^{0.9}$	0.748	0.837	0.898	0.964	1.0	1.11	1.17	1.336	1.50	1.71	1.93	2.09
$(\rho_G/\rho_L)^{0.5}$	0.108	0.117	0.128	0.137	0.145	0.151	0.159	0.172	0.186	0.194	0.202	0.212
X	0.113	0.137	0.161	0.185	0.203	0.235	0.260	0.322	0.39	0.462	0.545	0.62
Φ_L	17	14.6	13.0	11.9	11.0	10.0	9.3	8.0	7.2	6.4	5.8	5.4
Liquid vis., cp.	0.5	0.4	0.4	0.35	0.35	0.35	0.35	0.35	0.33	0.33	0.3	0.3
$(1-x)\,DG/\mu_L$	161,000	265,000	254,000	280,000	275,000	290,000	300,000	318,000	355,000	375,000	431,000	444,000
f	0.00419	0.00378	0.00382	0.00375	0.00375	0.00372	0.00370	0.00365	0.00358	0.00353	0.00344	0.00342
$D\rho_L/[2\Phi_L^2\,f\,(1-x)^2]$	26.4	34.5	39.0	43.5	48.5	53.5	57.8	68.2	75.8	86.7	98.3	106.5
Cumulative length	....	0	0.91	3.73	8.0	14.3	20.6	37.5	60.0	84.0	108	140
Temperature, °F.	....	634	637	640	645	650	655	657	660	665	....	....

*Coil exit at 172 psia. and 670° F. found by interpolation.



PRESSURE DROP in the transfer line is found by graphical integration. Point where furnace tubing joins transfer line is found by interpolation from Table 3. Fig. 4.

at 100 ft., which is the length of the transfer line. The reversal of the curve at the lower left indicates critical-flow conditions and occurs at a little over 50 psia. The integration is in the direction away from the fractionator or the reverse of the direction of flow, thus the area under the curve is negative as called for in Equation 7a. The point where the furnace tubing joins the transfer line is found to be at 172 psia. and 670° F. by interpolation from Table 3 and plotted on Fig. 2.

Radiant section . . . Heat is absorbed in the radiant section at the rate of 30,000 B.t.u./hr./sq. ft. of heated surface. Since the pressure drop is calculated back from the tower, the enthalpy of the oil will be decreased at a uniform rate back through the furnace. This is calculated in the following manner.

$20{,}000 \times \pi \times 4/12 = 21{,}000$ B.t.u./hr. per foot of heated length.

$\frac{21{,}000}{91{,}000} = 0.231$ B.t.u./lb. per foot of heated length

$0.231 \times 40/55 = 0.168$ B.t.u./lb. per foot of equivalent length.

The equivalent length of travel in the radiant zone is $55 \times 16 = 880$ ft.

Table 3 indicates that at a point 40 ft. back into the furnace, the pressure would be 200 psia. This is not exactly correct because the enthalpy is not constant; but it will serve as a first approximation. The enthalpy at that point is $431 - 40 \times 0.168 = 424$ B.t.u./lb. This results in a different per cent vaporized and therefore a different set of densities. Using this approximation and reading the per cent vaporized from Fig. 2 the first line of Table 4 is calculated. The revised point is then plotted on Fig. 4. This point lies higher upon the curve above the adiabatic portion representing the path through the transfer line. A new area is calculated which represents length in the furnace and a revised enthalpy is checked. This trial-and-error method is carried on until the calculated enthalpy fits the density and vaporization used in arriving at the length of travel. Because of the larger volumes to be plotted, these data are replotted in Fig. 5. A simultaneous extrapolation on Fig. 2 and Fig. 5 is helpful in choosing values for each new pressure calculated.

Initial vaporization . . . From Table 4 the point of initial vaporization occurs at a point 388 ft. (equivalent) from the exit in the radiant section. The pressure is 301 psia. and the temperature is 610° F.

The remainder of the radiant section is $880 - 388 = 492$ ft. (equivalent) length. The enthalpy at the junction between the convection and radiant section is $431 - 880 \times 0.169 = 282$ B.t.u./lb. This corresponds to a temperature of 500° F. Since this flow is single phase liquid, the pressure drop may be calculated by the Fanning equation.

$$\text{Reynolds Number, } DG/\mu = 3/12 \times \frac{516}{0.22 \times 0.000672} = 875{,}000$$

$$f = \frac{0.046}{(875{,}000)^{0.2}} = 0.003$$

The pressure drop is

$$\Delta p = \frac{2 f G^2 L}{144 D g \rho} = \frac{2 \times 0.003 \times (516)^2 \times 492 \times 12}{144 \times 3 \times 32.2 \times 37.5} = 18.1 \text{ psi.}$$

The pressure at the junction between the radiant and convection section is

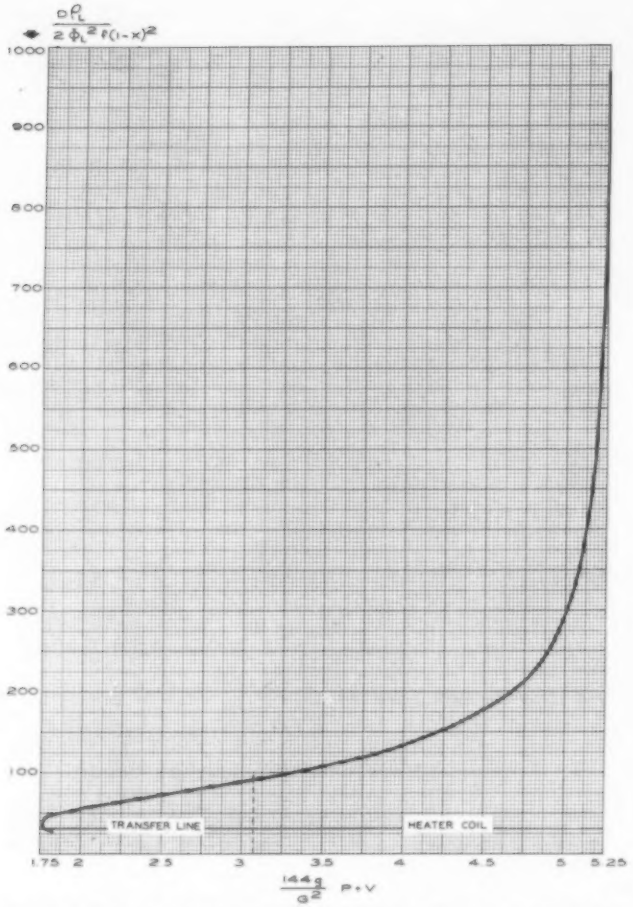
$$301 + 18.1 = 319 \text{ psia.}$$

The length of travel in the convection section is $21 \times 55 = 1{,}155$ ft. (equivalent). The mass velocity is half that in the radiant section, 258 lb./sec.-sq. ft.

Reynolds Number, DG/μ

TABLE 4—DATA FOR PRESSURE DROP IN RADIANT SECTION

p (psia.)—	200	225	250	275	290	300	301
$(144g/G^2)\,p + V$	3.645	4.044	4.45	4.87	5.10	5.24	5.25
T	660	653	650	635	625	615	610
x	0.275	0.21	0.15	0.09	0.05	0.01	0.0
1 − x	0.725	0.79	0.85	0.91	0.95	0.99	1.0
ρ_L	41	40	39	38	37	37	37
ρ_G	1.86	1.94	2.04	2.13	2.2	2.22	....
$(\mu_L/\mu_G)^{0.1}$	1.4	1.39	1.38	1.35	1.35	1.35	....
$[(1-x)/x]^{0.9}$	2.3	3.29	4.76	8.05	15.5	63	0.0
$(\rho_G/\rho_L)^{0.5}$	0.213	0.22	0.225	0.237	0.244	0.245	....
X	0.69	1.00	1.48	2.58	5.1	20.8	0.0
Φ_L	5.1	4.3	3.5	2.8	2.15	1.45	1.0
Liquid vis., cp.	0.28	0.25	0.25	0.20	0.22	0.22	0.22
$(1-x)\,DG/\mu_L$	497,000	606,000	651,000	875,000	875,000	865,000	865,000
f	0.00334	0.0032	0.00316	0.003	0.003	0.003	0.003
$D\rho_L/[2\Phi_L{}^2 f (1-x)^2]$	112	136	172	244	370	750	1,540
Radiant L, cum.	41	89	153	285	303	378	388
H	424	416	405	391	380	367	355



FURNACE PRESSURE DROP is found by graphical integration. Values from this plat and from Fig. 2 are used together until the correct pressure drop is found. Fig. 5.

$$= \frac{3}{12} \times \frac{258}{0.32 \times 0.000672} = 300{,}000$$

$$f = \frac{0.046}{(300{,}000)^{0.2}} = 0.0037$$

The pressure drop is

$$\Delta p = \frac{2 f G^2 L}{144 D g \rho}$$

$$= \frac{2 \times 0.0037 \times (258)^2 \times 1.155 \times 12}{144 \times 3 \times 32.2 \times 41}$$

$$= 12.0 \text{ psi.}$$

The pressure at the inlet to the furnace is 319 + 12 = 331 psia.

These last two points are plotted on Fig. 2 to complete the curve although they are outside the phase envelope.

4. What About Friction Factor?

Concerning friction loss through return headers Maker[2] notes: "Headers may be allowed for by adding an equivalent length. This requires reducing the value of the heat-absorption rate correspondingly so that in effect the same heat is spread over the equivalent length. Alternately, the friction factor f can be increased to take care of losses through headers . . .

". . . For heaters and stocks in which the evaporation takes place over a considerable length of tube, involving many return bends, the easiest way is to compute the equivalent length of the return bends and add it to the length of the tubes. The ratio of this total equivalent length to the actual tube length is computed and is inserted in the expression for the pressure drop per unit length. This is the method used by Dittus and Hildebrand . . . In effect it increases the friction factor to take care of losses at the return bends."

Maker then considers the case where evaporation takes place over a small length of coil, say only a few tube-lengths back. In this case velocity pressure losses in return bends may be relatively large and header losses may then be computed separately for each tube length.

Value of f . . . Dittus and Hildebrand use a Darcy or Moody friction factor value of 0.02. Maker uses 0.025. This latter value is in line with that used by some heater manufacturers. Experience has shown that it includes a safety factor which may amount to as much as 25-30 per cent. Dittus and Hildebrand used three velocity heads per return header. To keep the ratio of tube diameter to length the same, Maker accordingly uses 2.64 velocity heads per return bend.

Actually, whether an equivalent length is used (return-bend losses distributed along the tube) or the return bend loss is lumped, does not make too much difference when one considers the latitude involved in guessing at the friction factor. Also, as Maker emphasized, f does not have too great an influence on the pressure drop. But choice of one f value or another will change the shape of the pressure curve. This is illustrated in Fig. 4 where curves are presented for Fanning friction factors of 0.004, 0.005, and 0.006, as well as the curve obtained by the Lockhart-Martinelli correlation. (The friction factor values just mentioned are Fanning friction factors and are one-fourth as large as the Darcy-Moody friction factor—e.g., the value of 0.02 used by Dittus-Hildebrand or the 0.025 used by Maker).

Not a "simple" f . . . Since a "simple" f like the Fanning or Darcy does not really apply for the flow of a vaporizing liquid, the Lockhart-Martinelli correlation for two-phase flow was incorporated here for the complete calculation—in the transfer line and back through the heater. Note, however, that the Lockhart-Martinelli correlation involves a constant V/L ratio. Actually, in the problem under consideration, the V/L ratio keeps changing as vaporization takes place.

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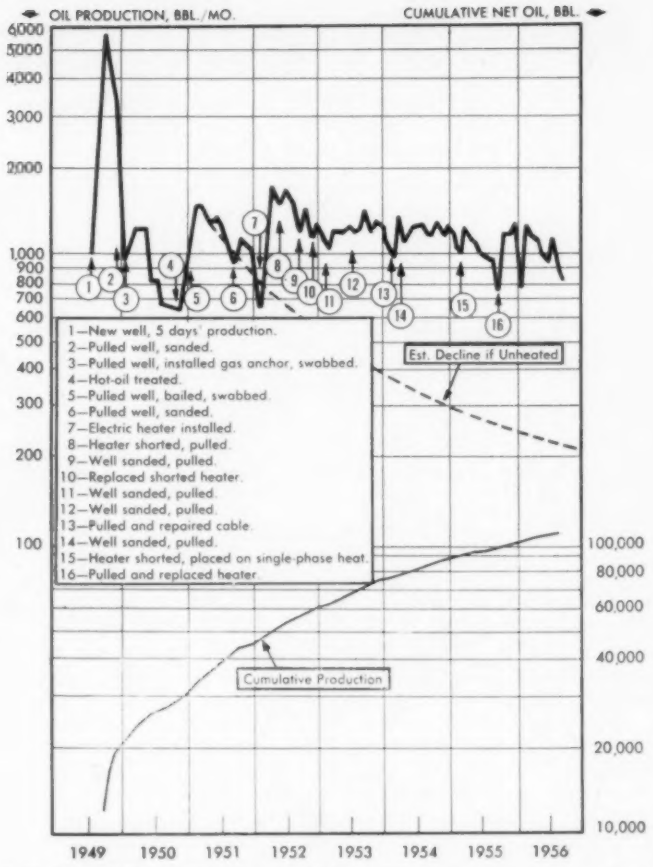
Bottom-Hole Heating

. . . speeds flow of heavy California oil

Part 2 of Two Parts

Numerous wells more than double the production rate before heating. In some wells there has been no production decline for several years after heating started. Average cost of heating California wells is about $2 per day.

By D. H. Stormont
District Editor



USE OF HEAT in a Placerita well of Intex Oil Co resulted, as shown here, in about 40,000 bbl. more oil being produced in 5 years. Fig. 12.

CASE HISTORIES of numerous California wells show that bottom-hole heating has proved quite profitable in a number of fields. Most installations have been in partially depleted fields. In some cases they are run in wells immediately upon completion, making a profitable operation out of what otherwise would be noncommercial production.

More oil recovery . . . An outstanding example of the benefit of down-the-hole heating is offered by the production record of a Placerita well (Fig. 12). It has been continuously heated for more than 5 years. During this period it produced about 40,000 bbl. more oil than would have been recovered if heat had not been applied.

Completed by Intex Oil Co. in the latter part of 1949, in a portion of the field developed on 2½-acre spacing, the 2,322-ft. producer hit a peak monthly production of 189 bbl. daily in December. Decline was rapid. By December 1950 oil production was down to 20 bbl. daily.

Hot-oil treating was tried with success but in the latter part of 1951 this practice had to be stopped. Because of low field pressures, too much oil was lost to the formation.

. . . Installation of an electric heater, as discussed in Part 1, immediately increased production from 20 bbl. to 76 bbl. daily. Decline has since occurred but at a less than normal rate. Last year production averaged about 30 bbl. daily, as compared with the 48-bbl. rate during the first 8 months after heating was started. Currently, after a cleanout job, it is producing 37 bbl. daily.

Cost of heating the well, on a 30-minute-on, 30-minute-off cycle for 8 hours daily, was about $1.50 per day last year. Bottom-hole temperature maintained has been around 148° F. As reflected in the production record, sand has been a problem but almost no water accompanies the 16°-gravity crude.

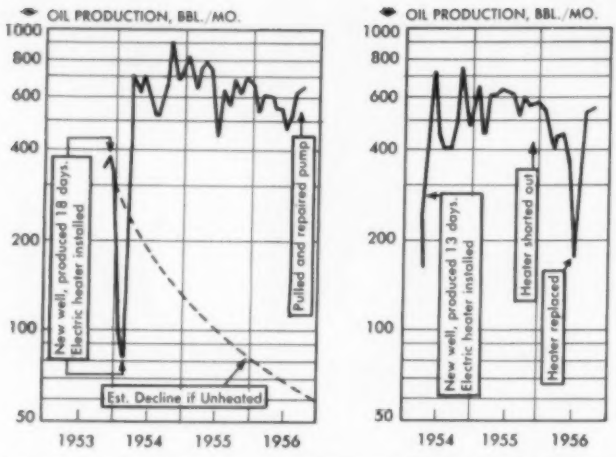
How heating benefited two other Intex Oil Co. wells is shown in Fig. 13. These Cymric wells, in westside San Joaquin Valley, produce from a 1,400-ft. shaly sand. Because of the high viscosity of the 14°-gravity crude, the wells are noncommercial without heat. Their initial production, unheated, is only 3 or 4 bbl. daily.

Intex installed electric heaters in these wells after they had been on production for about 2 weeks. Heating increased their output to 25-30 bbl. daily. Little decline has occurred during the more than 2 years the wells have been heated. Their production is still in the 20-bbl. range.

As of last September, Well A is estimated to have produced 17,000 bbl. more oil than it would have unheated. Well B had produced about 13,000 bbl. during its shorter life.

Midway-Sunset field . . . One operator at Midway-Sunset has had hot-water circulating heaters installed in 27 wells for periods ranging from a few months to more than 3½ years. Initial increases in the order of 800 per cent were shown in some cases. The average long-term increase, after normal decline has occurred in most wells, has been about 5 bbl. daily. Heating was tried in 12 other wells but was discontinued because of sand problems, excessive water cut, or failure to show an economic increase in oil output.

Average depth of wells in this area is about 1,350 ft. The oil produced



TWO NEW Cymric wells were noncommercial before heat was applied. Well on left has now produced more than 17,000 bbl.; well on right, more than 13,000 bbl. Fig. 13.

is highly viscous and has a gravity of approximately 11° A.P.I.

Unheated wells range in production from 2 to 40 bbl. of oil daily, with the average being about 14 bbl. Some wells produce a high percentage of sand. Water cut in some is too high to consider use of bottom-hole heaters.

A study made last June, when heaters had been installed in 23 wells for an average of 12.2 months, showed that heating had resulted in an average increased oil output of 5 bbl. daily per well. It was estimated that heating resulted in the production of approximately 44,750 bbl. more oil than would have been produced without heating.

Sustained responses . . . Production records of five wells which responded the greatest, and have been heated the longest, are shown in Figs. 14 to 18, inclusive. Also shown are the depths at which the pump shoe and heater were installed, periodic fluid-level tests, and well-completion data.

The well whose history is shown in Fig. 14 is of interest because it has been heated the longest. From a 3-bbl. per day producer it jumped to 17 bbl. daily within 1 month after heat was first applied in June 1953. For the next year or so it averaged about 10 bbl. daily. During last January it produced 7 bbl. daily.

In the first 31 months of operation it was estimated that heating had resulted in the production of 6,230 bbl. more oil than would have been recovered under unheated conditions. On a daily basis oil production thus had been increased 6.6 bbl. daily.

Fig. 15 shows the production record of the Midway-Sunset well which responded best to heating. When the heater was installed in October 1954, daily net oil production was slightly over 20 bbl. By the following April it had approximately doubled and in December production peaked at 47 bbl. daily.

During the first 18 months of heating it was estimated that 9,350 bbl. more oil had been produced than would have otherwise. This represented a 17-bbl. daily gain for the period. Last January daily oil output was almost 30 bbl. above what the projected unheated output would have been.

Two wells, on another lease, which were greatly stimulated by heating are shown in Figs. 16 and 17. Heating jumped the output of the well shown in Fig. 16 from about 8 bbl. daily to 12 bbl. daily, where it has remained for 2 years. During the first 15 months heat was used at the other well (Fig. 17) oil production increased an average of 7 bbl. daily.

Heating a well on a third lease resulted in an average increase in oil output of 5 bbl. daily during the first 18 months (Fig. 18). The heater and pump have not been removed, nor any remedial work performed, during the 2 years the heater has been in operation.

. . . Average fuel requirement of these single gas-fired heaters has been 12 M.c.f. of gas daily. Of this volume about 7 M.c.f. is obtained from the casing of the heated well. Maintenance of surface equipment has been almost negligible to date.

Well-pulling jobs to change pumps and bail sand have run slightly above the average for unheated wells. By June of last year it was estimated their use had resulted in an additional expense of $6,700, of which about $5,000 was spent on two wells.

Another company is applying heat to 11 Midway-Sunset wells. Unheated, these wells produced 105 bbl. of oil daily. Periodic treatments with hot oil resulted in their output being doubled. Down-the-hole heating resulted in their output being maintained at more than 300 bbl. daily for the past year. And production is still tending to increase.

. . . At Placerita another company is heating seven wells, four with hot-water-circulating heaters and the others with electrical. Average response for the year or more the heaters have been installed has been a 100 per cent increased oil output —from 15 bbl. to 30 bbl. daily.

Production record of the well which has been heated the longest is shown in Fig. 19. The well was completed in 1950 for 113 bbl. daily of 12.5°-gravity crude. With 8⅝-in. casing set at 1,259 ft. a 6⅝-in. slotted liner was run to 1,618 ft. total depth.

By April 1952 oil production had declined to 32 bbl. daily. When the 70,000-B.t.u. per hour electric heater was installed in December 1954, oil output had further declined to 26 bbl. With the heater set at 1,540 ft. and the pump shoe at 1,439 ft., oil production was up to 50 bbl. daily within 2 months. Water cut dropped from 14 to 10 per cent.

As shown in Fig. 19 oil production immediately started declining at about the same rate as had the unheated well during the previous 2 years. Projection of the unheated curve indicates that heating has resulted in the recovery of about 10,000 bbl. more oil than would have been recovered. Heater and cable failures offset a good portion of this increased production but a payout was realized.

. . . At Yorba Linda, bottom-hole heating has made development of a shallow, low-gravity zone more economically feasible. Average oil production from the 275-ft. oil sand found in the 600-ft. wells has been increased about 10 bbl. daily. Furthermore, most of the 50 wells being heated have shown little or no decline, though some have been producing for almost 3 years.

Western Gulf Oil Co., which took the lead in heating at Yorba Linda, has 28 shallow wells completed on 2½-acre spacing. Their average heated output is 36 bbl. gross and 24 bbl. net oil daily. The wells range in gross production from about 18 to 40 bbl. daily. When heat is temporarily stopped they decline to about half this level within a matter of hours.

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ETHYL STUDY ANALYZES INDUSTRY OCTANE POTENTIAL TO 1960

New report can help in your future refining plans

by C. J. WOLF, Ethyl Corporation Refinery Technologist

Ethyl Corporation has undertaken this study to evaluate the effects of present and future refinery processes on the antiknock quality of the motor-gasoline pool in the United States.

The octane potential of the United States refining industry from 1955 to 1960 has been analyzed for the United States as a whole and, separately, for the various regions—East, Midwest, Gulf, Rocky Mountain, and West Coast. The effects of present and future refinery processes in general, and the catalytic reforming process in particular, have been the primary variables evaluated.

Secondarily, changes in crude type, the ratio of domestic-to-foreign crude run, and the composition and disposition of those products from petroleum that influence the quality and yield of gasoline have also been taken into account.

Influence of refining techniques

ETHYL studies indicate that the octane number of the total motor-gasoline pool in the United States increased by 0.9 Research octane number (RON) and by 0.8 Motor octane number (MON) from the fall of 1955 to the fall of 1956.

During this period, the portion of the U.S. refining industry utilizing catalytic reforming increased from 66 to 81 per cent (based on projected crude-running capacity). Total catalytic-reforming capacity, including spare capacity, increased from 10.6 per cent of crude run in 1955 to 12.9 in 1956.

Industry saturation of catalytic reforming in this country as a whole has been estimated at 16.0 per cent of crude run. This saturation is for virgin-naphtha feed only, and it is estimated that it will be reached in the fall of 1957.

Saturation of catalytic reforming is expected to take place by this time in all regions of the U.S. except in the Rocky Mountain region, where saturation is forecast for the fall of 1958.

The octane potential after the fall of 1957 will primarily be influenced by the severity of catalytic reforming, catalytic reforming of heavy thermal naphtha, aromatic extraction with raffinate recycle, and maximum use of alkylation for motor fuel after compliance with aviation-gasoline demand.

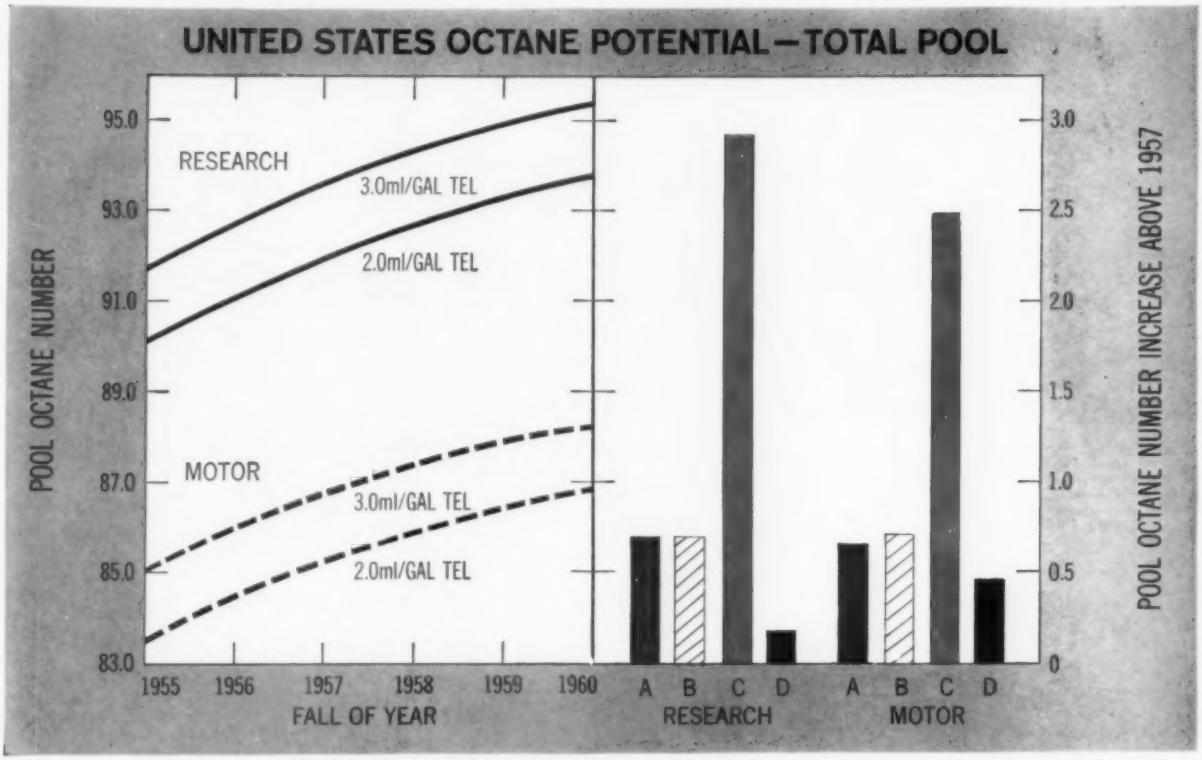
A summary of the catalytic-reforming growth in the United States is presented in the table below.

The effects of the growth or decline of refinery processes other than catalytic reforming during the 1955-1960 period have also been evaluated in this study. Growth is expected in catalytic cracking, catalytic polymerization, and alkylation in terms of percentage of crude run, during this period. In the same terms, decline is expected in thermal operations—visbreaking, coking, and thermal cracking.

CATALYTIC REFORMING

Per Cent of Crude Run

Fall of Year	1955	1956	1957
East	9.4	11.7	17.0
Midwest	11.0	13.1	16.9
Gulf	10.8	13.7	15.1
Rocky Mountain	1.9	7.2	11.9
West Coast	12.7	13.7	15.9
Total U. S.	**10.6**	**12.9**	**16.0**



The weighted regional-pool octane number potentials of total U.S. pool gasoline are shown from 1955 to 1960. The maximum octane increases obtainable from: **A.** increased reforming severity, **B.** reforming heavy thermal naphtha, **C.** aromatic extraction and reforming raffinate from straight run charge, and **D.** maximum alkylation are shown for the total U. S. gasoline pool. The weighted proportions of these refinery processes in use after 1957 were calculated from projected refinery economics.

Thermal reforming, with the exception of that planned for use in conjunction with catalytic reforming, has been considered to be non-existent when saturation of catalytic reforming of virgin-naphtha is achieved in 1957.

Increases after 1957

AFTER 1957, the maximum octane increase obtainable by more severe catalytic reforming, use of reforming capacity for heavy thermal-naphtha charge, aromatic extraction and raffinate recycle, and maximum alkylation will be about 4.6 RON and 4.2 MON for the total United States.

Depending on the region, this maximum potential octane increase can range from 4.2 to 5.2 RON and from 3.8 to 5.0 MON. The amount of this maximum potential octane increase that is actually employed by 1960 will vary from region to region.

Use of the above-cited refinery processes by 1960 could increase antiknock value of the total 1957 United States pool by about 1.7 RON.

The costs of octane improvement and local area conditions will dictate relative use of these more severe refinery operations.

In general, it is felt that increasing reforming severity to average a yield of about 80 per cent debutanized reformate will be almost universally employed throughout the industry by 1960.

The use of aromatic extraction and raffinate recycle and of catalytic-reforming capacity for heavy thermal-naphtha charge will be practiced by only one-third of the industry in 1960. It is believed that use of these processes will vary between 0 and 40 per cent, depending on the region.

Maximum alkylation above and beyond that required for aviation gasoline will be practiced by about 20 per cent of the industry as a whole, and in the various regions, with the exception of the Rocky Mountain area.

HOW ETHYL RESEARCH CAN HELP YOU

To assist refiners in obtaining the most economical routes to high-octane fuels, Ethyl Research maintains a close watch on trends in refinery processing. Recent studies of crude sources, processing and product yields provide a realistic evaluation of the octane potentialities of motor gasolines. The major findings are summarized for you here. A complete report entitled "U.S. Refining Octane Potential 1955-1960" is available through your Ethyl Representative.

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85° F. the oil is heated to about 145° F. This temperature increase results in the viscosity of the 12.8°-gravity crude being reduced from 45,000 to 2,200 S.s.U.

Primarily because of the low heat requirement of the shallow wells, company-designed heating systems are used at Yorba Linda. Individual heaters, equipped with copper tubing and rated at 190,000 B.t.u. per hour, are used. Complete cost of equipping each well for heating is approximately $900. Payout for this type equipment is only a matter of a few months.

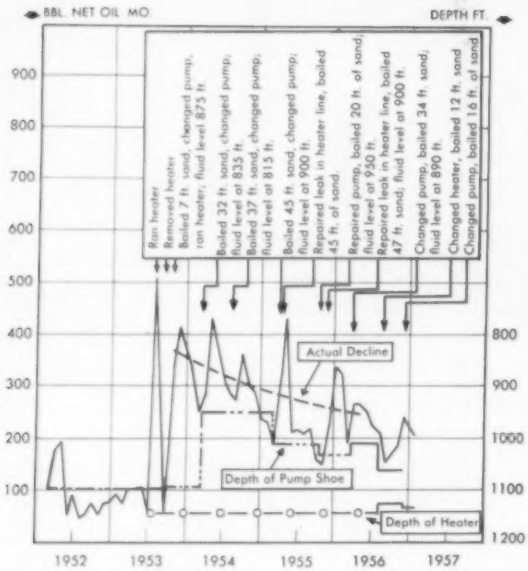
Design . . . Outlet temperature of the water from the heater is maintained at about 210° F. It returns at approximately 180° F., after supplying some 70,000 B.t.u. per hour to the produced crude and formation. Steam-tracing of the flow lines is not needed.

The 1-in. circulating lines are banded together but are independent of the tubing string. This is in contrast to the usual hookup, where the exchanger is part of the tubing string and the macaroni lines are clamped to the tubing. This hookup permits the rods and pump to be pulled and bailing performed through the tubing. It also allows the pump shoe to be set at any desired depth and a stringer run to bottom to keep the hole free of sand.

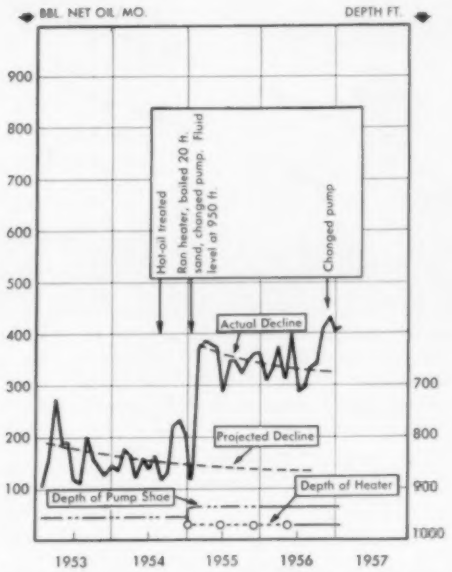
Practices Followed

Most effective heating would be obtained by placing the pump shoe at the top of the liner and the

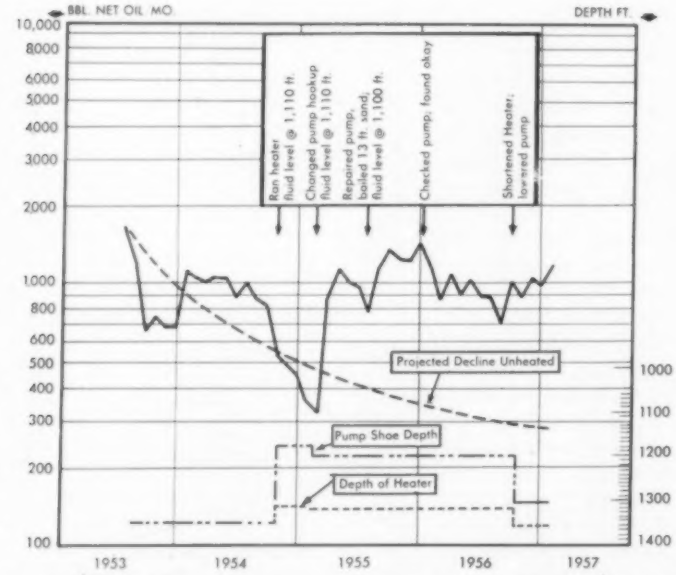
MIDWEST-SUNSET WELLS RESPOND TO BOTTOM-HOLE HEATING . . .


BBL. NET OIL MO.
DEPTH FT.
Ran heater
Removed heater. Bailed 7 ft. sand, changed pump, ran heater; fluid level 875 ft.
Bailed 32 ft. sand, changed pump; fluid level at 835 ft.
Bailed 37 ft. sand, changed pump; fluid level at 815 ft.
Bailed 45 ft. sand, changed pump; fluid level at 900 ft.
Repaired leak in heater line, bailed 45 ft. of sand.
Repaired pump, bailed 20 ft. of sand; fluid level at 950 ft.
Repaired leak in heater line, bailed 47 ft. sand; fluid level at 900 ft.
Changed pump, bailed 34 ft. sand; fluid level at 890 ft.
Changed heater, bailed 12 ft. sand
Changed pump, bailed 16 ft. of sand
Actual Decline
Depth of Pump Shoe
Depth of Heater
900
800
700
600
500
400
300
200
100
800
900
1000
1100
1200
1952
1953
1954
1955
1956
1957

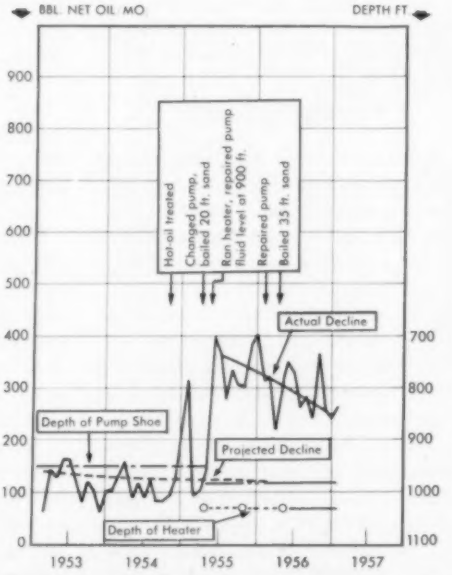
INCREASE was over 6,000 bbl. of oil during first 31 months of heating. Fig. 14.



MARGINAL WELL became profitable producer. Fig. 16.



OVER 9,000 BBL. more oil was produced after heat had been applied for 18 months. Fig. 15.



PROFIT is obtained from this former marginal well. Fig. 17.

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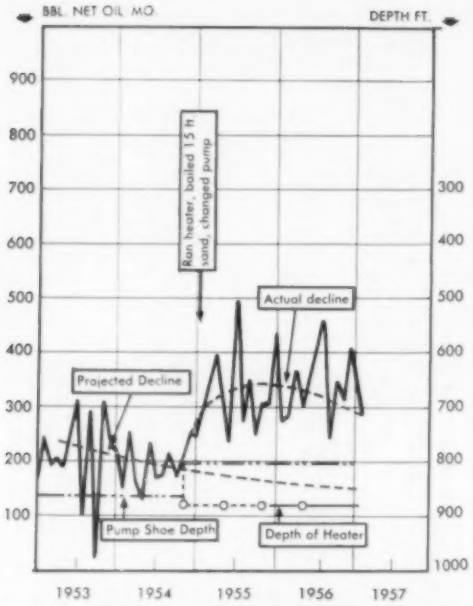


OUTPUT INCREASED 5 bbl. daily from this Midway-Sunset well after heating began. Heater has operated 2 years without being moved. Fig. 18.

heater at the bottom of the liner, assuming that conditions were uniform throughout the oil sand. However, most efficient drainage of oil into the well bore of an unheated well will occur if the pump is placed at the bottom of the liner.

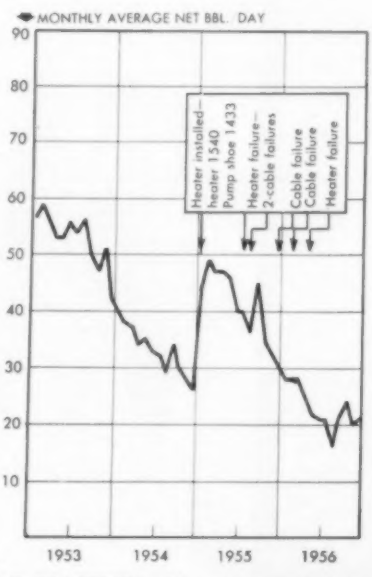
Since these two factors are in direct opposition, the optimum point for setting the pump shoe is neither at the top nor bottom. It is some point in between, depending upon formation pressure and effectiveness of the heat to increase oil flow into the borehole.

In practice the optimum depth could be determined by trial and error. But since this involves considerable expense, and the volume of oil production involved usually is small, the pump shoe often is set at a point about two-thirds up from bottom of the producing zone. In many cases it is not changed, regardless of performance, until some remedial work requires a servicing unit.

Effect of fluid level . . . Setting the pump high results in a column of hot fluid being held on the face of the sand. Experience has shown this is necessary as dry heat will not melt the asphaltic and wax deposits in the liner and on the sand face. It merely drives out the light fractions and produces a much harder deposit.

If the fluid level is held too high, flow of oil into the well bore may be reduced because of the additional back pressure. In low-pressure zones this can result in offsetting the advantages of heating. Only through trial and error can the proper setting of the pump shoe be determined.

Effect of fluid level on one well's production is shown in Fig. 15. With the pump shoe set at 1,195 ft. and heat exchanger set at approximately 1,310 ft., the well's oil output had dropped to about 30 bbl. daily. Lowering the pump intake to 1,305 ft. and shortening the heater resulted in about a 5-bbl. daily increase.



AT PLACERITA this well responded to heat immediately. In 2 years, oil production has been increased about 10,000 bbl. Fig. 19.

. . . The sanding problem, one company has found, can be lessened by preheating the well before it is produced. After the heater is run, heat is applied for 3 to 5 days before the pump is started up. Heat imparted to the formation lowers the crude's viscosity so that less sand is carried to the well bore, it is believed.

In wells which produce substantial amounts of sand, caution must be taken to set the subsurface heater far enough off bottom that its operation is not endangered by the inflow and settling of sand within the liner. There have been instances where sand reduced oil flow to such an extent that charring occurred.

Where this situation exists the usual solution is to raise the heater. But this may lead to the pump becoming gas-locked, as one operator found out in some of its Placerita wells where electrical heaters are used.

In these wells the heater was set just off bottom and the pump near the top of the pay. A solid baffle just below the pump shoe forced the heated oil to enter the pump through a perforated nipple placed below the baffle. This hookup resulted in sand accumulating in the stringer.

The sanding condition was remedied by raising the heater just below the pump. To prevent the crude from passing directly from the heater to the pump, it was required to enter a stinger run nearly to bottom. This circulation of oil kept the hole free of sand. But in a well producing much gas the pump frequently became gas-locked.

To solve this situation, small check valves were installed just below the top lock shoe. These permit the gas to bleed from the pump into the casing annulus on each stroke of the pump. Since these were installed, neither sand nor gas has been a problem.

Cost of Heating

Heaters are being used in wells ranging in depth from a few hundred feet to about 5,000 ft. Their cost of installation varies according to depth, type of heating, and number of wells heated from a unit.

Hot-water-circulating systems are cheaper than electrical heaters, both in first cost and operation. Where field gas is available they operate quite cheaply, despite the loss of heat up the hole. Where gas is not available, electrical heaters are used. In addition to their advantage of confining all heating to the oil zone, they are better adapted to intermittent heating.

Limited experiences of one company indicate the electric heater is more economical than the circulating type under the conditions involved in some Placerita wells. Included in their evaluation was the ease of well repair and maintenance of surface equipment. When these factors were considered, another operator estimated it was costing only 7 cents more per day to electrically heat (as compared with a circulating heater) 2,300-ft. wells.

Another company using both electric and circulating heaters estimated their costs as follows:

		Cost of Unit Installed	
Well depth, in ft.	600	1,600	2,600
Hot-water circulating	$2,400	$3,000	$3,500
Hot-oil circulating	4,800	5,000	5,400
Electrical resistance	4,000	5,000	6,500
	Operating Costs (Per Month)		
Hot-water circulating	$81	$81	$81
Hot-oil circulating	143	169	196
Electric resistance	133	133	133

The operating costs are based on field gas valued at 25 cents per 1,000 cu. ft. and electricity at 1.2 cents per kilowatt-hour. In all types continuous heating is employed. These figures do not include the expense of maintaining the subsurface equipment.

Average cost of heating California wells is about $2.00 per day. Costs reported vary principally with the value placed on fuel gas or the price which must be paid for purchased electric power. At Yorba Linda heating with gas valued at 17 cents is estimated to cost about $1.00 daily. At Midway-Sunset one operator figures its cost at $2.00 per day. Using electric heaters on an intermittent basis, 15 minutes on and 15 off, another company gave its cost at $75 per month.

Additional Benefits

Higher production does not give a complete picture of the value of bottom-hole heaters. Other benefits realized, but which are not directly reflected in higher oil production, include:

1. Many wells now using down-the-hole heaters would have to be given periodic hot-oil treatments to keep their production up.

2. Rod loads are lessened by the lowered viscosity, resulting in less frequent rod failures and more normal loads on the gear boxes.

3. Pulling time to change pumps is lowered where insert-type pumps can be used. Their use is impossible in some unheated wells due to the highly viscous crude unseating the holddown device.

4. Usually it has been possible to discontinue heating the flow line, where formerly it had to be heated to prevent excessive back pressures.

5. Some heat is lost down the hole and in flow lines but dehydration heat load is substantially reduced where circulating heaters are used. Treating temperatures of 150° to 170° are quite common to effect rapid settling of water. At some leases where bottom-hole heating is used only 15° heat must be added at the dehydration tank.

Another unevaluated factor is the additional oil produced from wells nearing their economic limit. Applying heat makes their operation economic. Though the amount cannot be determined, some of the added oil resulting from heating thus may be classed as secondary-recovery oil since it would not have been recovered by primary methods.

Insofar as stripper wells are concerned, heating may have the effect of materially shortening their producing life. Instead of the remaining oil reserve being recovered in 20 years, for example, it may be produced in 10 years by bottom-hole heating. Thus it may effect a substantial savings through the elimination of operating costs. **End.**

BOOKS

GAS CHROMATOGRAPHY by A. I. M. Keulemans. Published by Reinhold Publishing Corp., 430 Park Avenue, New York 22. 217 pp. $7.50.

The principles of gas chromatography are spelled out, both in their practical and theoretical aspects. Here is a concise practice manual and an up-to-the-minute summary by chemists who have been active investigators in the field for many years.

The book reveals the simplicity of gas chromatography, a simplicity that cuts analysis time to a fraction of that taken by more tedious methods. The book shows how to identify the individual components of a gas or a vapor in a way that is rapid, positive, reliable, and accurate.

There are many applications described. The nature and potential uses of this analytical tool are described in a clear, logical manner.

DEPARTMENTS OF GEOLOGICAL SCIENCES in the Educational Institutions of the United States and Canada. Published by the American Geological Institute, 2101 Constitution Avenue, N. W., Washington 25, D. C. 196 pp., $1.50.

The A.G.I. publishes this survey of colleges and universities that offer undergraduate and graduate degrees in geology and geophysics. The catalog lists the standard curriculum for each college as well as the requirements for the various degrees offered. The faculties for each college are also listed.

INDEX MAP ON 184 OF CENTRAL MID-CONTINENT REGION giving lines of sections that show detailed lithology of paleozoic and mesozois rocks. Compiled by Jeannette Fox and Mary G. Sheldon. Published by the U. S. Geological Survey, Department of the Interior, Washington 25, D. C.

This new U.S.G.S. index map shows the location of cross sections that give detailed lithology of Paleozoic and Mesozoic rocks. The index cross-sections cover distances of not less than 50 miles. The sections are located on a base map of the central United States that shows the principal tectonic features. A table gives the following location for each of the cross-sections indexed: Title and location, author, publication or source, and date.

Note: The Oil and Gas Journal maintains a book department. Write to the READER SERVICE DEPARTMENT, P. O. Box 1260, Tulsa 1, for copies of the book list. Often books reviewed here may be purchased from this source.

Nelson Refinery Construction Index

Appears in the Engineering Section in the first issue each month.

Compiled by W. L. Nelson, petroleum refinery consultant, Tulsa.

The Index was explained October 1, 1956 (page 110) as well as the Indexes of Individual Items of Equipment that appear on the Cost-imating page in the first issue of the months of January, April, July, and October.

	Index (1946 = 100)					
	1949	1952	1954	1955	1956	March 1975
Pumps, compressors, etc.	135.9	155.6	166.5	172.2	192.0	203.3
Electrical machinery	130.9	152.4	160.0	162.5	175.0	186.9
Internal-combustion engines	124.8	146.5	150.5	153.2	164.0	173.3
Instruments	123.1	146.2	154.6	162.9	182.1	186.2
Heat exchangers	133.0	165.8	171.7	156.8	190.7	195.9
Miscellaneous equipment average	*121.6	153.3	160.7	161.5	180.5	189.1
Materials component	143.6	164.3	174.6	176.1	190.4	199.1
Labor component	137.1	163.1	183.3	189.6	198.2	203.6
Nelson construction index	139.7	163.6	179.8	184.2	195.3	201.8

*Used in computing the Nelson Index until April 1952. This is slightly different from the average of the Miscellaneous Equipment Items shown above.

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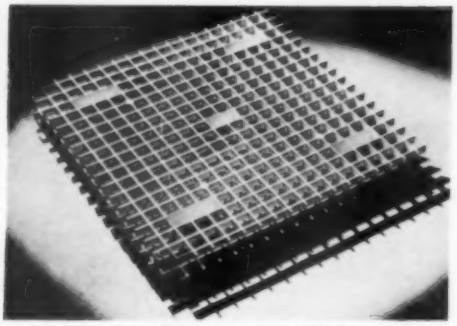
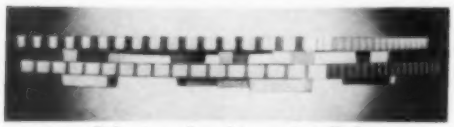
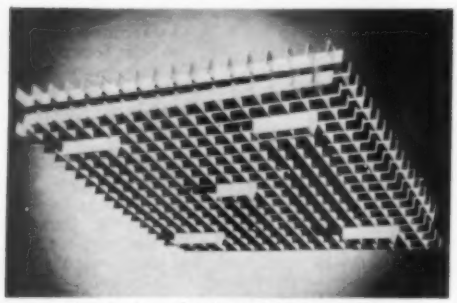


Overall top view as installed



Side view of packing as installed



Bottom view showing spacing supports

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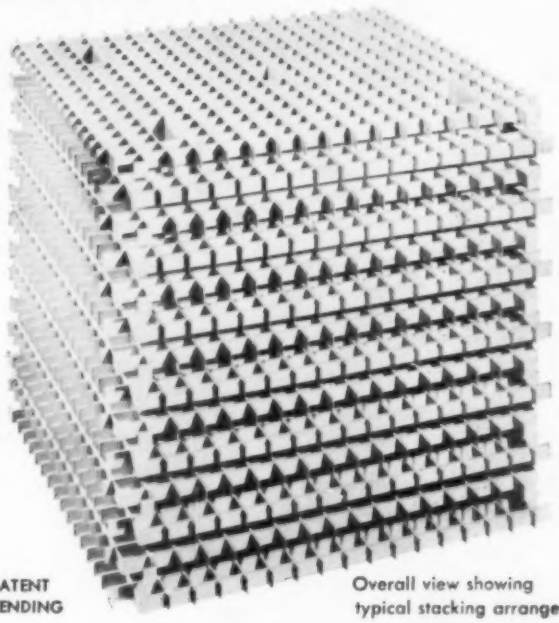

PATENT PENDING

Overall view showing typical stacking arrangement

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18 days saved, 50 per cent fewer bits used. That's the score shown by four wells, by using . . .

Seven Steps to Faster Drilling

A drilling program is only as successful as the combined efforts put forth by the operator and the contractor. This analysis of four wells drilled in North Louisiana shows how time was reduced 18 days and bits per well cut in half with proper application of the drilling machinery and experience gained on previous wells.

By R. W. True and Gene Bowman

PROPERLY to evaluate a rig's drilling-penetration ability, one must consider the various factors that contribute to the total rig performance. In many instances the geographic location and the penetrated geological section remain essentially constant, but individual rig practices vary enough to change over-all rig performance. The success of the drilling operation depends primarily upon the initial program outlined.

Improved drilling rates are possible through the close cooperation between an operator and the contractor in providing the following:

1. A well-integrated study of the area to be drilled.
2. A properly designed casing program.
3. Adequate rig and competent personnel to drill proposed test.
4. Selection of proper bits for formations to be penetrated.
5. Sufficient bit weight for maximum penetration.
6. Hydraulic efficiency at maximum through entire operation.
7. A good mud program which should provide:

(a) Increased mud volumes to allow lower viscosities than used in the past.

(b) Relaxed water-loss specifications where possible.

(c) Greater use of oil-emulsion muds.

(d) Reduction of solids content to minimum.

(e) Reduction of sand content to minimum, thereby increasing bit lift.

(f) That the hole characteristics of each individual well should govern the final mud program used.

Authors are with Big Chief Drilling Co., Oklahoma City. Paper presented at 1957 spring meeting of the Southern District, A.P.I. Division of Production, Shreveport, under original title, "Rig Performance in the North Louisiana Area."

This article describes four wells drilled in the same area and the progress made in reducing drilling time on each subsequent well. A true picture of rig operations could be obtained from the fact that the same rig with the same crew members was present on each location. The four wells were drilled to the Smackover formation in Claiborne Parish of North Louisiana.

Drilling tests . . . The geological section has been divided into four zones with the rig-performance records applied to each zone:

Zone	Depth (ft.)
1	0-3,900
2	3,900-5,300
3	5,300-7,300
4	7,300-(*)

*To coring depth Smackover formation.

Sediments in Zone 1 include the rocks of Quaternary, Tertiary, and Upper Cretaceous ages. The Lower Cretaceous is included in Zones 2 and 3. Jurasic sediments make up Zone 4, below 7,300 ft. down to the Smackover.

Drilling equipment . . . The type of equipment used is described in Table 1. Additional auxiliary equipment has been installed since the first test, but

TABLE 1—RIG SPECIFICATION SHEET (RIG 31)

Draw works—Type B-800. Maximum input horsepower 900. Maximum low-clutch line pull 880,000 lb. with 10 lines. Draw works equipped with new type 46-in. single-rotor hydromatic brake and overrunning clutch.

Compounding transmission—B-800 with maximum input horsepower rating of 1,200. Equipped with 27½-in. fluid-coupling drives, each engine; two 18-in. pump drives.

Engines—Three six-cylinder rated at 374 hp. each. Total maximum horsepower available, 1,122.

Pumps—Two 7¾ by 16-in. high-pressure type; 8,000-psi. test; 4,500-psi. working pressure. These pumps are late-type, high-speed, high-volume design for jet drilling (equipped with supercharger).

Blowout equipment—Two 10-in. Series 1500 fluid-operated preventers. One 10-in. Series 1500 Hydrill. Drilling spool with choke and kill lines, etc.

Slush Pits—Three steel circulating pits, 7 ft. 6 in. by 5 ft. 6 in. by 29 ft. (1,213 bbl. each).

Shale shaker—Vibrating type driven by hydraulic motor to minimize fire hazard.

Crown block—Six 42-in.-diameter sheaves built into derrick.

Traveling block—TB-300; 300-ton capacity; five 42-in. sheaves.

Hook—Type 4300; 300-ton capacity.

Swivel—300-ton capacity with full 3-in. bore; fluid wash pipe.

Rotary table—20½-in. maximum i.d.; 250-ton capacity tapered roller-bearing assembly.

Drill pipe—4½-in. 16.6-lb. Grade E, equipped with 4½-in. full-hole tool joints.

Drill collars—As needed—8-in. o.d. by 3-in. i.d. by 30 ft. long with 5½-in. H90 connections and 7-in. by 2¾-in. i.d. by 30 ft. long equipped with 5-in. H90 connections.

Derrick—133-ft. special service heavy-duty cantilever type, 700,000-lb. capacity. 15,600-ft. racking capacity for 4½-in. drill pipe; 11-ft. substructure with 4-ft. extensions (if desired). Steel pipe racks and walks.

Efficient depth range—This new rig has been deliberately designed for the widest possible depth range. It will compete with, and out-perform, the average medium-depth (8,000-ft.) rig. Drilling can be done with 4½-in. drill pipe to 12,500 ft. or deeper.

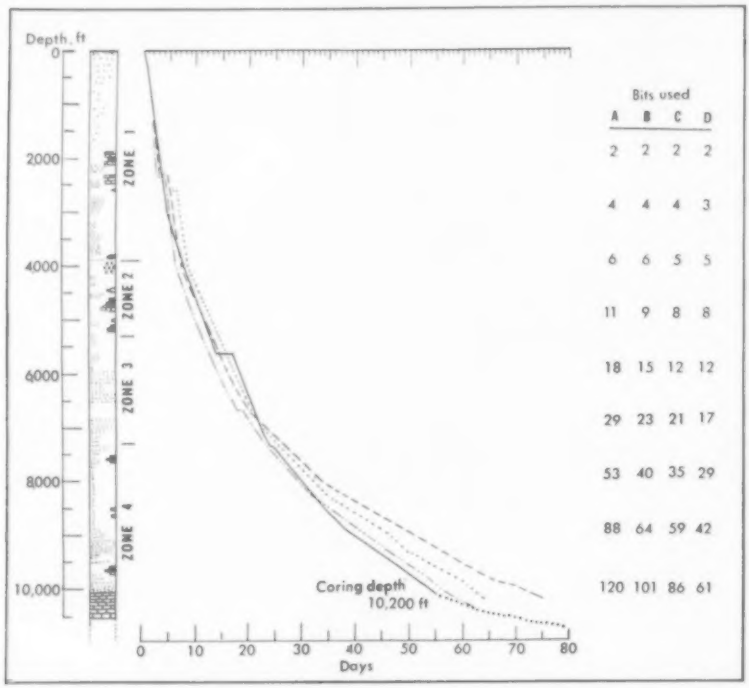
Engine house—Rig was designed and equipped with first glass-fiber engine house in the industry. This material is shatterproof, fire-resistant, and transmits light. As a result, time required for rig maintenance is reduced and the assembly is very pleasing in appearance.

the major drilling equipment remains unchanged.

One will note that the rig was basically equipped to perform most any type of program within its rated depth range. The backbone of any rig operation, to be sure, is the horsepower available at the compound. The rig used was amply powered with three 374-hp. six-cylinder engines which could provide conservatively speaking, 650 hydraulic horsepower to the mud-pump system.

Too often in the past a rig has been rated on the maximum horsepower rating of the draw works, regardless of the rig horsepower available. However, a general trend of late has been to properly qualify a rig by its available compound horsepower. True, an ample draw works is necessary even in the medium-depth range for hoisting the drilling string. The major emphasis, however, should be placed on the available horsepower for pumping.

Considerably more time is lost with a rig with a unit of insufficient horsepower and a large draw works than a rig which is amply powered but has a conservative draw-works rating. As an example, for drilling in the 10,000-ft. range, a rig provided with a 1,200 maximum engine horsepower and only a 600-hp. draw work has proved to be more efficient than a rig equipped with an 800 engine horsepower and a draw-works rating of 1,000 hp.



DRILLING CURVES in North Louisiana area show that additional operating cost was far outweighed by the increased penetration rate. Fig. 1.

Hydraulics . . . Time lost drilling as a result of the poor fluid hydraulics can increase the drilling cost as much as 20 per cent on a 10,000-ft. well. The drilling string used on Wells A, B, and C consisted of 4½-in. full-hole drill pipe and 7½-in. o.d., 2⅞-i.d. drill collars for drilling the surface holes and 9-in. hole to the top of the Smackover formation. On Well D a different casing program was in effect and 8 by 3-in. drill collars with 4½-in. drill pipe were used for drilling the 12¼-in. hole to 5,600 ft. to enable the setting of 9⅝-in. casing below this string of casing. Also 7¼ by 2¾-in. drill collars were used for an 8⅝-in. hole.

As shown in Table 1, two 7¾ by 16-in. mud pumps were provided. These pumps ran in parallel from the surface to approximately 6,700 ft. This program was put into effect with minimum trouble because fluid-type drives were provided on each engine-output shaft.

This parallel type of operation was accomplished with an addition of about 20 per cent pump-repair time in comparison to the normal one-pump operation. This increased repair time was the result of the additional volume circulated and the abnormal pressure surges during parallel operations. However, as the drilling curves (Fig. 1) will indicate, this additional operating cost was far outweighed by the increased penetration rate possible under these conditions.

Rig Performance Analysis

Zone 1 . . . Drilling time on all four wells in question (Table 2) revealed little variation in the penetration rates. In drilling Zone 1, 0 to 3,900 ft.,

TABLE 2—RIG-EFFICIENCY RECORDS

	Well A		Well B		Well C		Well D	
	Time (hr.)	Per cent	Time (hr.)	Per cent	Time (hr.)	Per cent	Time (hr.)	Per cent
Total time available for drilling	1,749.25	100.00	1,551.00	100.00	1,389.00	100.00	1,239.50	100.00
Drilling time	977.25	55.87	907.00	58.48	861.50	62.03	817.50	65.96
Trip time	492.25	28.14	405.75	26.16	308.25	22.19	212.00	17.10
Straight hole and Lub.	92.00	5.26	86.75	5.59	83.25	6.00	79.25	6.39
Ream and wash	58.25	3.33	5.75	0.37	19.25	1.37	19.25	1.55
Repairs	129.50	7.40	145.75	9.40	107.25	7.73	102.50	8.27
(a) Draw works	27.75	1.59	29.25	1.89	39.75	2.86	35.25	2.84
(b) Pumps	5.00	0.29	26.50	1.71	18.75	1.35	18.75	1.51
(c) Engines	2.75	0.16	21.25	1.37	10.50	0.76	9.50	0.77
(d) Drill collars and drill string	3.00	0.17	21.00	1.35	8.00	0.58	6.25	0.51
(e) Compound unit	6.50	0.37	4.25	0.28	2.25	0.16	2.75	0.22
(f) Misc. (24 hours after tearing down)	84.50	4.82	43.50	2.80	28.00	2.02	30.00	2.42
Average tripping time	3 hr. 55 min.		3 hr. 55 min.		3 hr. 30 min.		3 hr. 31 min.	
Average drilling time, ft. per hour	10.67		11.85		12.27		13.10	
Additional days: trip time and time on bottom required as compared with the best well record	18.0		11.1		5.5		....	

approximately one-third of the rig time was used setting conductor and surface strings.

The casing program for Wells A, B, and C is as follows:

Depth (ft.)	Hole size (in.)	Casing set (in.)
250	20	16
2,500	13¾	10¾
10,600 (core hole, TD)	9	7

The casing program for Well D differed only in the setting of the second string. At 5,600 ft., 9⅝-in. casing was set instead of the 2,500-ft., 10¾-in. casing string of the other wells.

Five bits were used to penetrate the first 3,900 ft. of hole—an average of 780 ft. per bit. Included in the bit total average are surface, reamer, and the 9-in. bits. Average drilling time was 7 days from spud (See Table 3).

Native mud of low viscosity and low weight was used in the initial drilling stages of each well. As in the case of most surface-drilling situations, frequent jetting of the pits and a high volume of water makeup was necessary because of the rapid accumulation of sand and solids in the circulation system.

Zone 2 . . . Formations penetrated in Zone 2, 3,900 to 5,300 ft. (Table 4), consist of approximately 125 ft. of solid anhydrite with the remaining portion of 1,275 ft. predominantly shale, with beds of 10 to 15 per cent sand stringers and 15 to 20 per cent lime sections. The rapid penetration rates possible in these strata indicated the unconsolidated nature of the formation present in top-hole drilling sections.

Penetration per bit increased from 155 ft. on Well A to 279 ft. on Well C. This represents an increase of 80 per cent in penetration ability. The bit weight remained constant, 3,300 lb. per inch of bit diameter; but the mud-circulation rate was increased 110 g.p.m. or 22.5 per cent. Also, conventional bits were used on the first well, and jet-nozzle bits were used on the remaining tests.

Ordinarily, a nozzle velocity of 175 ft. per second would be considered in the low range of effective jet-bit action, but the results indicated penetration-rate advantages even at this low velocity. Apparently the position of the nozzle rather than the nozzle velocity was mainly responsible for the reduction in drilling time. The eroding action of the mud and drilled solids in the fluid would shorten the life of a conventional bit as a result of the fluid passing over the body of the cones instead of being projected to the base of the hole. This is especially true in this case because of the high solid concentration in the drilling mud at this shallow depth.

. . . Annulus velocity was also increased from 195 ft. per minute on Well A to 275 ft. per minute on Well C. This increase in lifting capacity reduced the fallout of drilling cuttings between trips, and less time was needed to wash to the bottom with a new bit.

The 12¼-in. hole, Well D, was drilled with the same number of bits as Well C, but the drilling time was 1½ days longer. This was due to the lower annulus velocity of the bigger hole, even though the nozzle velocity was increased by 55 ft. per second, or 31.5 per cent, and weight per inch of bit diameter was increased to 3,650 lb.

In comparing the muds one should note the water loss of drilling fluid. On the first two wells, water losses of 14 cc. were recorded at 5,300 ft. as compared to 24 cc. and 35 cc. on the other tests. Recent research reports reveal the adverse effect of water-loss control on drilling rates. These data support results revealed previously.[1] The drilling fluid was water-gel mixture; and, although a low viscosity was maintained, the removal of drilling cuttings was adequate because of the high circulation rate at this depth. Little or no trouble resulted from this procedure.

Zone 3 . . . The firmness of the Hosston section (Taylor sand, Travis Peak, Pettet lime, etc.) drilled in Zone 3, 5,300 to 7,300 ft., is exhibited in the bit consumption (Table 5). This geological column is composed of 50 per

TABLE 3—RIG PERFORMANCE IN ZONE 1, 0 TO 3,900 FT.

Well—	A	B	C	D
Drilling days	7	8	6.5	6.5
Bits	Each well five bits: 12¼-in., reamer bits, and 9-in. bits.			
Feet per bit	780 ft. penetration per bit.			
Average mud circulation rate, g.p.m.	630	675	675	755
Nozzle velocity, ft./sec.	Conventional	290	290	390
Drilling Mud				
Weight, lb./ gal.	9.3 to 9.6			
Viscosity, sec.	33 to 38			

TABLE 4—RIG PERFORMANCE IN ZONE 2, 3,900 TO 5,300 FT.

Well—	A	B	C	D
Drilling days	6	6	4.5	6
Bits, number and size, in.	9-9	6-9	5-9	5-12¼
Feet per bit	155	205	279	279
Weight per inch of bit diameter, lb.	3,350	3,350	3,350	3,650
Average mud circulation rate, g.p.m.	490	505	580	665
Annulus velocity, ft./min.	195	205	235	125
Nozzle velocity, ft./sec.	Conventional	145	175	230
Drilling Mud				
Weight, lb./gal.	9.8 to 10	10.2	9.7	9.7
Viscosity, sec.	35	35 to 37	34	33
Water loss, cc.	14.8	14	24.8	21-35
Volume per cent sand			0.75	0.35

TABLE 5—RIG PERFORMANCE IN ZONE 3, 5,300 TO 7,300 FT.

Well—	A	B	C	D
Drilling days	13.5	11	12	11
Bits, number and size, in.	26-9	19-9	15-9	10-8⅝
Feet per bit	77	105	135	200
Weight per inch of bit diameter, lb.	3,900	4,500	5,500	5,800
Average mud circulation rate, g.p.m.	425	445	575 to 6,700 ft. 445 to 7,300 ft.	640 to 6,700 ft. 475 to 7,300 ft.
Annulus velocity, ft./min.	170	180	180	220
Nozzle velocity, ft./sec.	Conventional	160	140 to 6,700 ft. 240 to 7,300 ft.	220 to 6,700 ft. 260 to 7,300 ft.
Drilling Mud				
Weight, lb./gal.	10 to 10.3	10.3 to 10.6	10 to 10.2	9.4 to 9.7
Viscosity, sec.	40 to 52	32 to 44	39 to 46	32 to 44
Water loss, cc.	8.4 to 5	21 to 5.4	14.1 to 7.2	28 to 14
Volume per cent solid	8 to 14	8 to 14	8 to 15	8.5
Volume per cent oil	0 to 15	0 to 14	0 to 13	0 to 9
Volume per cent sand	0.75 to 1.75	0.75 to 1.35	1.0 to 1.25	0.4

cent fine-grained, sharp sand sections with integrated gray, sandy-shale streaks.

A total of 26 conventional bits were used on Well A. To drill the same zone on Well C, 15 jet bits were used, 11 bits fewer than the first hole. Penetration increased from 77 ft. per bit on Well A to 135 ft. per bit on Well C. As stated previously, the jet nozzle rather than the mud velocity at the bit caused the increase in penetration rate.

... Effect of nozzle velocity is shown by Wells C and D. On Well C, 575 g.p.m. was used to a depth of 6,700 ft. with a jet nozzle velocity of 140 ft. per second. This same velocity pattern was used on Well D with an increase of nozzle velocity to 220 ft. per second from 5,600 to 6,700 ft. Comparing Well C and Well D between 5,600 to 6,700 ft., weight per inch per bit diameter was about the same, i.e., 5,500 lb. and 5,800 lb. A total of one bit and 20 rotating hours were saved in this short interval of hole drilled. The penetration rate on Well D was 16.4 ft. per hour or 4.8 ft. per hour more than the penetration rate recorded for Well C at the same depth.

Prior to the drilling of Well D, it was believed that the mud used was the major factor in increasing penetration rate. However, this well showed that nozzle velocity also increased penetration. A further increase in penetration rate was recorded on Well D, 6,700 to 7,300 ft. A total reductiontion of three bits and 23 rotating hours was made in drilling this 600 ft. as compared to the previous drilling time on Well C. The nozzle velocity was raised only 8.3 per cent.

Records of the drilling muds used on Well C and Well D from 5,600 to 7,300 ft. point to possible reasons why bits and days were saved on the last well. Filtration loss on Well D remained about 14 cc. throughout the section as compared to 7.2 cc. for Well C and 8.5 to 5 cc. of Well A. Solids per cent of the drilling fluid remained lower on Well D—8.5 per cent. Because of the low content of solids and sand the fluid weight on Well D was 9.7 lb. per gal.

Summarizing these results, the improved drilling rate on Well D in comparison with the other wells was attributed to:

1. Reduced sand content which increased bit life.
2. Reduced weight of drilling fluid which decreased column pressure.[6]
3. Water loss increased allowing penetration of drilling fluid into the well bore.[1]
4. Low solids percentage which increased bit life and reduced abrasive action of the drilling fluid.

Zone 4 . . . The high bit consumption of Well A in Zone 4 (Table 6) can be attributed to several factors. First, the weight per inch of bit diameter was 5,000 lb. or 16 per cent less than Well C and 28 per cent less than the bit weight used in drilling Well D. As previously stated, conventional bits were run throughout the drilling of the well.

An increase in penetration rate was noted on Well B once the proper jet velocity was attained at 8,950 ft. Prior to this depth, ⅛-in. nozzles were used with a resulting fluid velocity of 140 ft. per second. At this depth, the mud volume was reduced to 425 g.p.m. and ½-in. nozzles were installed in the bit, increasing the nozzle velocity to 230 ft. per second. Three fewer bits were required to drill from 8,950 to 10,000 ft.

On Well B the footage was drilled in 91 fewer drilling hours.

Well	No. of bits used	Footage drilled	Hours	Feet per hour
A	34	1,050	328	3.2
B	31	1,050	237	4.7

Total hours saved, including trip time, were 182. A rig of this size takes approximately $57 per hour to operate. Therefore, the cash savings in this portion of the hole amounted to $6,650.

The data indicate that Well D penetrated this 2,900-ft. section in less time than any previous well. This was accomplished with the same fluid nozzle velocity, but the bit weight per inch was increased from 6,100 lb. to 6,900 lb. Footage per bit was increased from 31.3 on Well A to 70 on the final hole.

Mud properties of the first three wells were similar. However, on Well D the mud weight was increased to 12.4 lb. at 9,400 ft. Normal penetration rates were maintained on this well to 10,200 ft. under these conditions.

A marked decrease in sand content was also noted (2.5 per cent to 0.75 per cent). This decrease resulted in longer bit life, and therefore reduced the total bits used. If the sand content had remained at 2 per cent, the bit consumption would have increased considerably; and the record run accomplished would have been impossible.

TABLE 6—RIG PERFORMANCE IN ZONE 4, 7,300 FT. TO TOP OF SMACKOVER (10,200 FT.)

Well—	A	B	C	D
Drilling days	46	39	37	32
Bits, number and size, in.	80-9	71-9	61-9	41-8⅝
Feet per bit	31.3	41	47.5	70
Weight per inch of bit diameter, lb.	5,000	6,100	6,100	6,900
Average mud circulation rate, g.p.m.	415	470 to 8,900 ft. 425 to 10,200 ft.	450	450
Annulus velocity, ft./min.	170	185	185	205
Nozzle velocity, ft./sec.	Conventional	140 to 8,900 ft. 230 to 10,200 ft.	315 to 8,170 ft. 245 to 10,290 ft.	245
Drilling Mud				
Weight, lb./gal.	10.6	10.7 to 11.3	10.2 to 11	9.8 to 12.6
Viscosity, sec.	47 to 56	45 to 54	49 to 54	45 to 53
Water loss, cc.	5.8	4	7.2	10
Volume per cent solid	15 to 8,000 ft. 19 to 10,000 ft.	14 to 7,300 ft. 23 to 10,200 ft.	15 to 7,300 ft. 21 to 10,200 ft.	10 to 7,300 ft. 23 to 10,200 ft.
Volume per cent oil	13	13	14	13
Volume per cent sand	1.5 to 2	1+	1.5 to 2.5	Trace to 0.75

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ELEMENTS OF FIELD PROCESSING—36

How Compressibility Affects Gas Flow

By Dr. John M. Campbell

AS PRESSURES have risen on natural-gas systems the assumption of ideal gases becomes less valid. It is therefore advisable, and convenient, to incorporate the compressibility factor Z into the flow equations to eliminate this error (see Part 34, May 27 issue).

There are several ways in which a compressibility factor may be incorporated into the equations derived under the assumption of ideal gases (Part 35, June 10 issue).

1. Use an average Z at some mean pressure for the section of line studied.
2. Express Z as a function of pressure and temperature.

Author is chairman, school of petroleum engineering, University of Oklahoma, Norman.

The use of an average compressibility factor Z_a is convenient, and determined at the average pressure P_a which in turn is found from the equation:

$$P_a = \frac{2}{3}\left[\frac{P_1^3 - P_2^3}{P_1^2 - P_2^2}\right] \qquad (1)$$

where P_1 and P_2 are the inlet and outlet absolute pressures respectively. When using this average compressibility factor the basic flow equation (Equation 10, Part 35) is written as:

$$Q = 38.77\,\frac{T_s}{P_s}\left[\frac{(P_1^2 - P_2^2)D^5}{fLGT_fZ_a}\right]^{1/2} \qquad (2)$$

The use of an average compressibility factor involves a trial and error solution if one of the pressures is unknown, i.e., where a pressure is to be determined for a given flow rate.

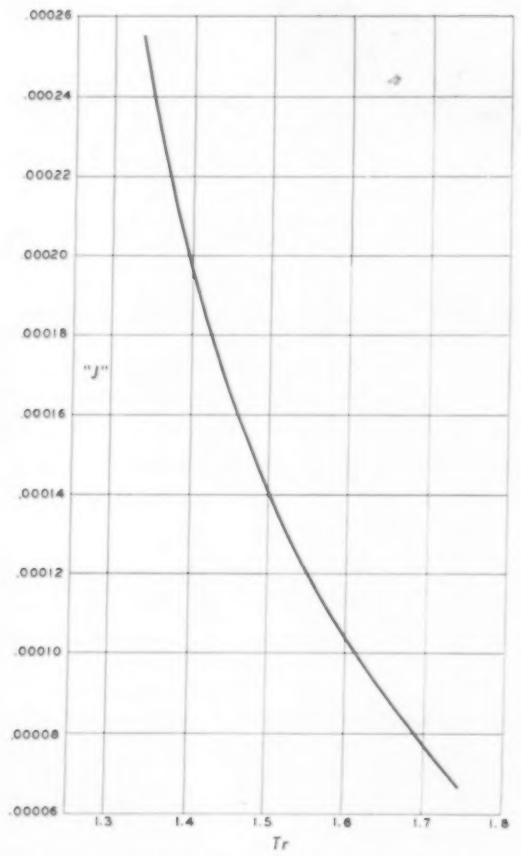
An alternate method is to express Z as a function of pressure with an equation of the form:[1 2 3]

$$\frac{1}{Z} = Y = C + JP^n \qquad (3)$$

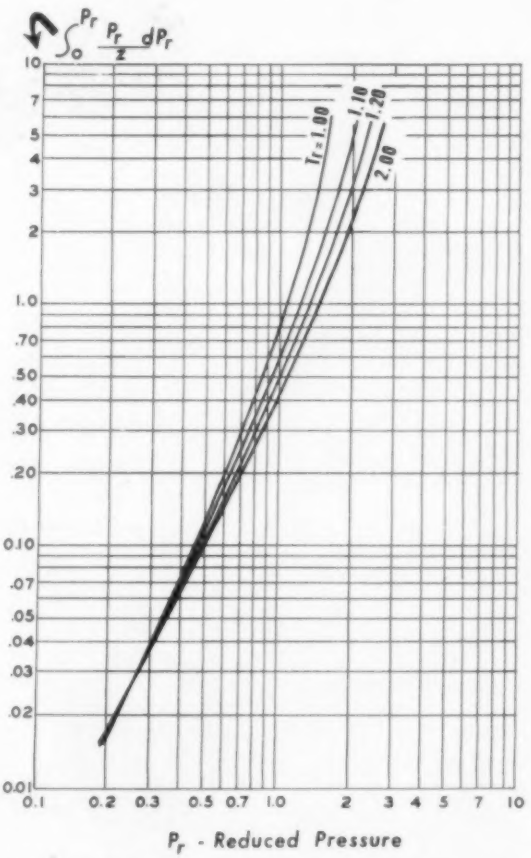
where J is a function of temperature only and n and C are arbitrary constants. In most pipeline applications C and n may be taken as 1.0 so that the equation simplifies to:

$$Y = 1/Z = 1 + JP \qquad (4)$$

The factor J may be easily handled as long as the flowing temperature is substantially constant, an assumption



VARIATION OF J FACTOR with reduced temperature, T_r. Fig. 1.



INTEGRAL OF $(P_r/Z)\,dP_r$ as a function of T_r and P_r. Fig. 2.

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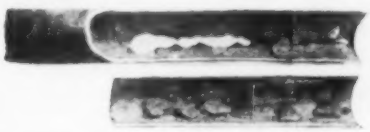
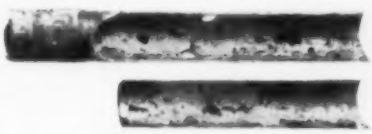


Cement Lined Steel . . . 14 months; total loss.



Plastic Coated Steel . . . 9 months; failure.

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that is generally satisfactory as long as the ground temperature does not change markedly. If the above expression is introduced into the differential form of the gas flow equation the basic flow equation may be written:

$$Q = 38.77 \frac{T_s}{P_s}\left[\frac{P_1^2(1+\frac{2}{3}JP_1) - P_2^2(1+\frac{2}{3}JP_2)}{fLGT_f}\right]^{1/2} D^{5/2} \quad (5)$$

The value of J for use in this expression may be found from Fig. 1.[3] The value of reduced temperature T_r for use on the abscissa is found by one of the methods discussed in Part 33.

The above procedure of assuming an ideal gas and then correcting the result by empirical means is questionable although the final result is very applicable. Clinedinst[4] has therefore derived an equation where the Z is incorporated throughout, the final result being:

$$Q = 54.83 \frac{T_s}{P_s}\left[\frac{\int_{P_2}^{P_1} \frac{P}{Z}\,dP}{fGTL}\right]^{1/2} D^{5/2} \quad (6)$$

when the equation is expressed in terms of the friction factor defined by Equation 6, Part 35.

This equation is equivalent to Equations 2 and 5 and may be used with any appropriate friction factor. The author,[4] however, proposes the correlation:

$$\log_{10}(4f) = -1.7447 - 0.010637D \quad (7)$$

The integral $\int (P/Z)\,dP$ obviously offers difficulty since Z is some function of P, which prevents direct integration. Graphical integration is possible but it is tedious and time consuming. Consequently several alternative methods of evaluating this integral have been developed.[1 4 5]

The integral may be solved by substituting the value of Z in Equation 4 into the integral, or:

$$\int_{P_2}^{P_1} \frac{P}{Z}\,dP = \int_{P_2}^{P_1} (P + JP^2) = \frac{J}{3}(P_1^3 - P_2^3) + \frac{1}{2}(P_1^2 - P_2^2) \quad (8)$$

A second solution is possible by expressing the integral in terms of reduced pressure, P_r.

$$\int_{P_2}^{P_1} \frac{P}{Z}\,dP = P_c^2 \int_{P_{r2}}^{P_{r1}} \frac{P_r}{Z}\,dP_r = P_c^2\left[\int_0^{P_{r1}} \frac{P_r}{Z}\,dP_r - \int_0^{P_{r2}} \frac{P_r}{Z}\,dP_r\right] \quad (9)$$

where:

P_c = critical or pseudocritical pressure

P_r = reduced pressure = P/P_c

Equation 9 may be conveniently solved by preparing a plot of the type shown in Fig. 2. The general application and accuracy of such a correlation are limited by the "Z" chart from which it is derived and the scale used for the data. However, the steepness of the curve in Fig. 2 introduces potential error, for a small error in P_r will give a magnified error in factor J.

A similar approach solves the integral by the use of "F" factors which are obtained from a generalized chart.[5]

Example problem . . . Determine the value of the integral,

$$\int_{P_2}^{P_1} \frac{P}{Z}\,dP$$

by two different methods for a natural gas having a critical temperature of 360° R. and a critical pressure of 672 psia., if the average flowing temperature is 65° F., the initial pressure is 946 psia. and the final pressure 638 psia.

Solution 1 (Equation 8):

$$T_r = \frac{460 + 65}{360} = 1.46$$

∴ From Fig. 1, J = 0.000159

Solution 1 (*Equation 8*)

$$\int_{P_2}^{P_1} \frac{P}{Z}\,dP = \frac{0.000159}{3}\left[(946)^3 - (638)^3\right] + \frac{1}{2}\left[(946)^2 - (638)^2\right]$$

$$= \underline{2.71 \times 10^5}$$

Solution 2 (*Equation 9*)

$$P_{r1} = \frac{946}{672} = 1.41, \quad P_{r2} = \frac{638}{672} = 0.95$$

From Fig. 2, $\int_0^{P_r} \frac{P_r}{Z}\,dP_r = 1.0 @ P_{r1} = 1.41$

$= 0.42 @ P_{r2} = 0.95$

$$\int_{P_2}^{P_1} \frac{P}{Z}\,dP = (672)^2(1 - 0.42) = \underline{2.61 \times 10^5}$$

The above difference is less than 4 per cent which is equivalent to the potential error as a result of using a slide rule on the above calculations.

Other methods . . . Several other convenient equations have been proposed for the solution of flow problems.[6 7] The equation of Poettman[6] is similar in form to Equations 6 and 9, except that the reduced integral is expressed as $(Z/P_r)\,dP_r$ and is integrated from 0.2 to P_r rather than 0 to P_r. Values of this integral are shown in Part 39 under the discussion of calculation of bottom-hole pressure. Baker and Swerdloff[7] have presented a basic solution of Equation 2 where the terms are conveniently consolidated in graphical form for easy solution.

It is obvious from the foregoing discussion that the designer of gas lines has a wide choice of equations. They differ primarily with the friction factor and the method of handling the compressibility factor. Most major pipelines, however, use some form of the Panhandle or Weymouth equations, as dictated by company policy. In the design of gathering systems the exact form used will not only depend on company policy, but on the inevitable personal preference of the individual engineer.

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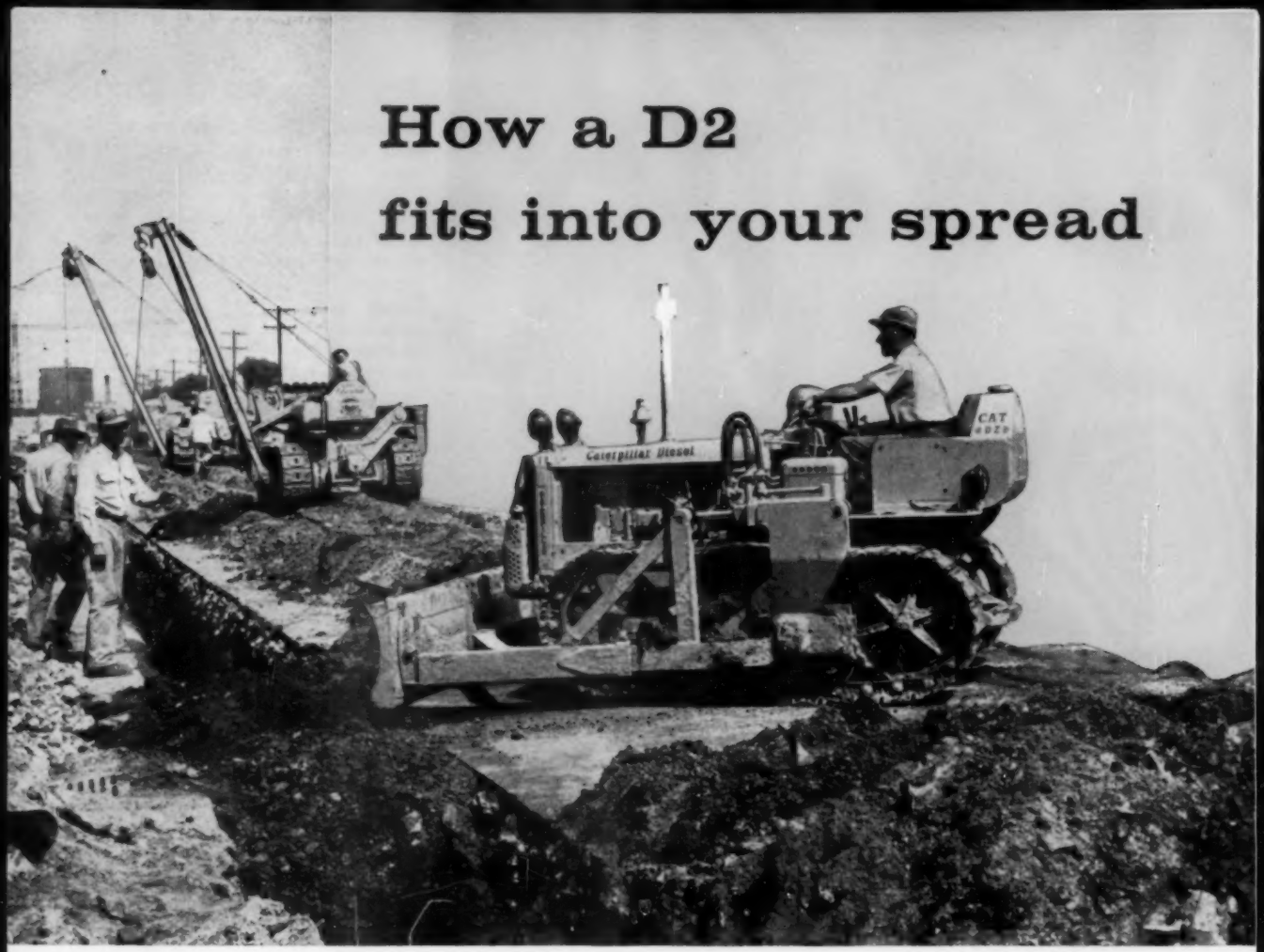

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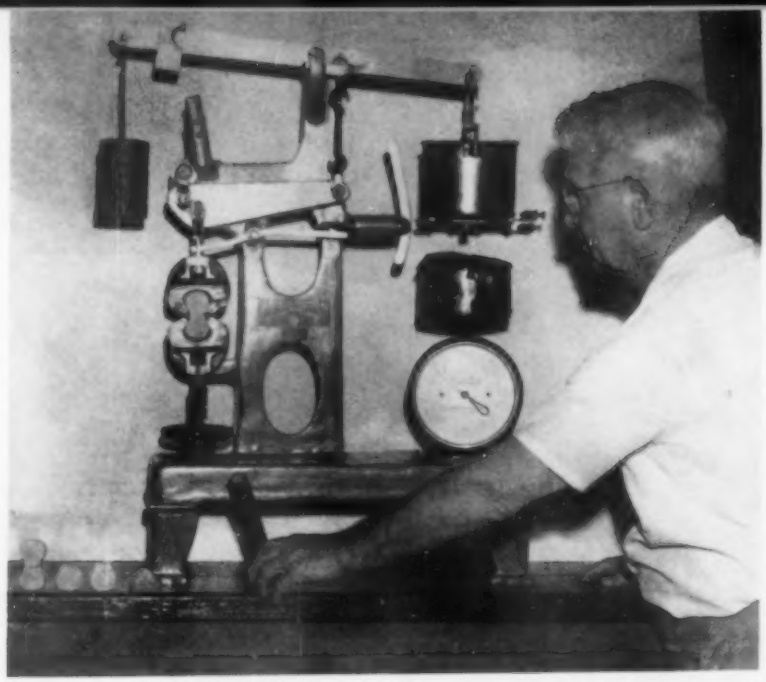


MEASURING tensile strength of San Andres limestone. Note the briquet failures of Grayburg limestone and typical compression type failure of Wolfcamp cube. Fig. 1.

For better drilling, cementing, fracturing, learn the

Tensile and Compressive Strength of Formations

Here's how some West Texas formations tested

By B. C. Craft

TENSILE and compressive strengths of rock formations have significant applications to petroleum engineering during drilling, cementing, and fracturing. Compressive strengths are of interest in the selection of optimum bit weights and in comparing bit records. In the case of oil-well cementing, good practice is considered to be use of a cement of at least equal strength to that of the producing horizon. Also related to this problem is the correlation of fracturing pressures and whether fracturing at depths is limited to the vertical fractures or joints.

Cores of a number of West Texas productive formations were first cut parallel to the bedding planes to a length of 5½ in. to provide horizontal planes for vertical cutting. The cores were then clamped in the chuck of a diamond saw and vertical slices 1 in. wide were cut 3 in. deep. A core was then rotated 90° and vertical slices 1½ in. wide were cut. A horizontal cut was then made 3 in. from the top. This resulted in either two or four 1 by 1½ by 3-in. tensile specimens at right angles to the bedding plane. The specimens were then ground to standard cement-briquet dimensions with a cross-sectional area of 1.00 sq. in. at the waistline.

Briquets were tested in accordance with the latest edition of A.S.T.M. C 190: Method of Test for Tensile Strength of Hydraulic Cement Mortars. Although the cores contained joints and bedding planes, only four briquets broke at the waistline during preparation. This indicates that the secondary calcite cementing material provided a good bond along the joints. Variations from the specified cross-sectional area (1.00 sq. in.) at the waistline were taken into consideration in the calculation of tensile strength.

Two-inch cube specimens were also cut from the cores with the diamond saw. Compressive strengths were made in accordance with the latest edition of A.S.T.M. C 190, and the load applied at a rate of 10,000 lb. per minute. Variations from the specified cross-sectional area (4.00 sq. in.) were taken into consideration in the calculation of compressive strengths.

Discussion of Results

Limited information is available on the tensile and compressive strengths of formations in any particular area. Scott[1] in a recent survey of the mechanisms of formation fractures, considers the tensile strength across bedding planes, inactive joints, and fractures will vary from zero to 200 psi., that of porous sandstones and limestones to range from 200 to 1,000 psi., and tight formations to have strengths up to 3,000 psi.

Table 1 shows the results obtained on representative cores. With two exceptions the samples were cut from the porous sections of the core which should have resulted in minimum tensile and compressive strengths. The dense, fine-grained San Andres and Clear Fork limestones gave the

TABLE 1—TENSILE AND COMPRESSIVE STRENGTHS

Formation	Depth	Tensile Strength, Psi. Max.	Min.	Avg.	Avg. Compressive Strength, Psi.
Grayburg	4,027	920	895	906	¶ 12,630
San Andres	4,162	1,695	983	1,295	15,800
Clear Fork	4,750	1,005	957	981	(+)
Clear Fork	4,750	1,413	906	1,212	
Spraberry	6,600	602	510	556	
Wolfcamp	8,500	635	291	435	11,400
Wolfcamp	8,505	856	*0		(‖)
Wolfcamp	8,539	310	†0		
Pennsylvanian	8,920	254	175	214	
Pennsylvanian	8,950	328	288	308	12,400
Devonian	10,450	263	238	254	8,215
Devonian	10,839	430	‡0		**9,420
Ellenburger	11,224	259	172	215	16,000
Ellenburger	11,274	1,195	§0		22,500

Briquet broke along bedding plane while grinding. † Contained horizontal and vertical joints. ‡ Broke along horizontal bedding plane or joint. § Broke along a vertical joint while grinding. ¶ Maximum 16,300 psi. + Core from 4,500 ft. had a maximum strength of 27,800 psi., minimum 24,100 psi. ‖ Core from 8,546 ft. had a maximum strength of 15,916 psi. ** Range 7,130 to 11,620 psi.

THE AUTHOR

B. C. Craft is professor and head of the petroleum engineering department at Louisiana State University, Baton Rouge. He received his A.B. and mining engineering degrees from Stanford University. He joined Louisiana State University in 1929 as assistant professor.

highest tensile strengths, exceeding 1,400 psi. The other cores from producing horizons which had strong oil or gas shows, had tensile strengths within the limits given by Scott.

Natural weaknesses . . . The tests also showed strengths opposite horizontal weaknesses developed by well-defined bedding planes or joints.

The Wolfcamp core from 8,539 ft. contained horizontal and vertical joints. While there was zero tensile strength at one point, the adjacent briquet developed 310 psi. tensile strength.

Considering the variations in porosity, grain size, and bedding, the tensile strengths for each core are considered to be highly consistent. A high-strength cement would be necessary for cement strength to equal or exceed these tensile strengths.

Compression . . . While in general the compressive tests were satisfactory, there was some variation in offset samples due to the inability to grind a perfectly smooth surface on some cubes and the presence of vugs in others. Where there was considerable variation, the maximum compressive strengths were included.

The high compressive strengths of the Ellenburger cores correlate very well with the bit weights required for drilling.

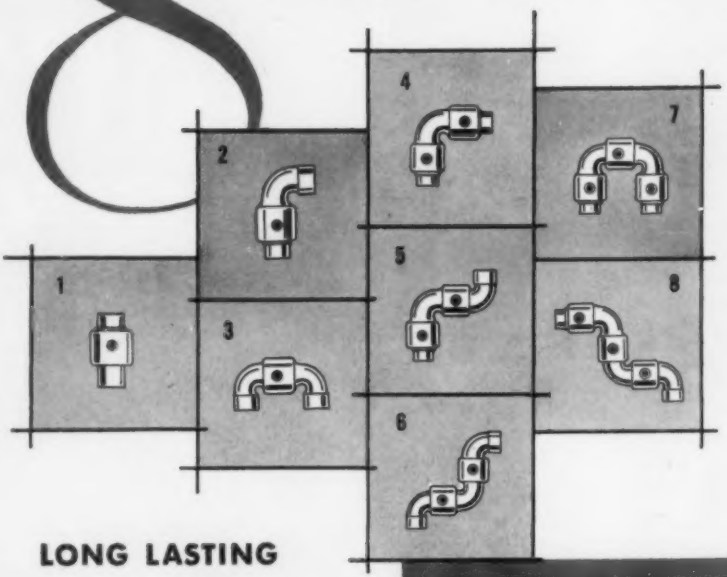
Acknowledgment

The author wishes to express his appreciation to James R. Sheeler and Joseph R. Christian, of Shell Oil Co., for furnishing the cores; to H. L. Moseley, of Trinity Portland Cement Division, General Portland Cement Co., for helpful suggestions and criticisms; and to Alva E. Lowman, of the civil-engineering department and Chester R. Best of the engineering mechanics department at Louisiana State University for their assistance in conducting the laboratory tests.

Reference

1. Scott, J. O.; "The Why and How of Fracturing," The Oil and Gas Journal, January 14, 1957.

8 EIGHT BASIC STYLES OVER 500 MODELS



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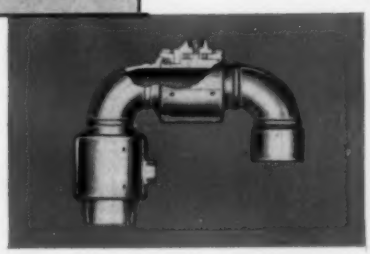

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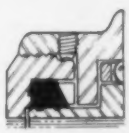
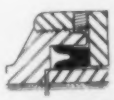


Grooved packing for high temperatures or corrosive services.



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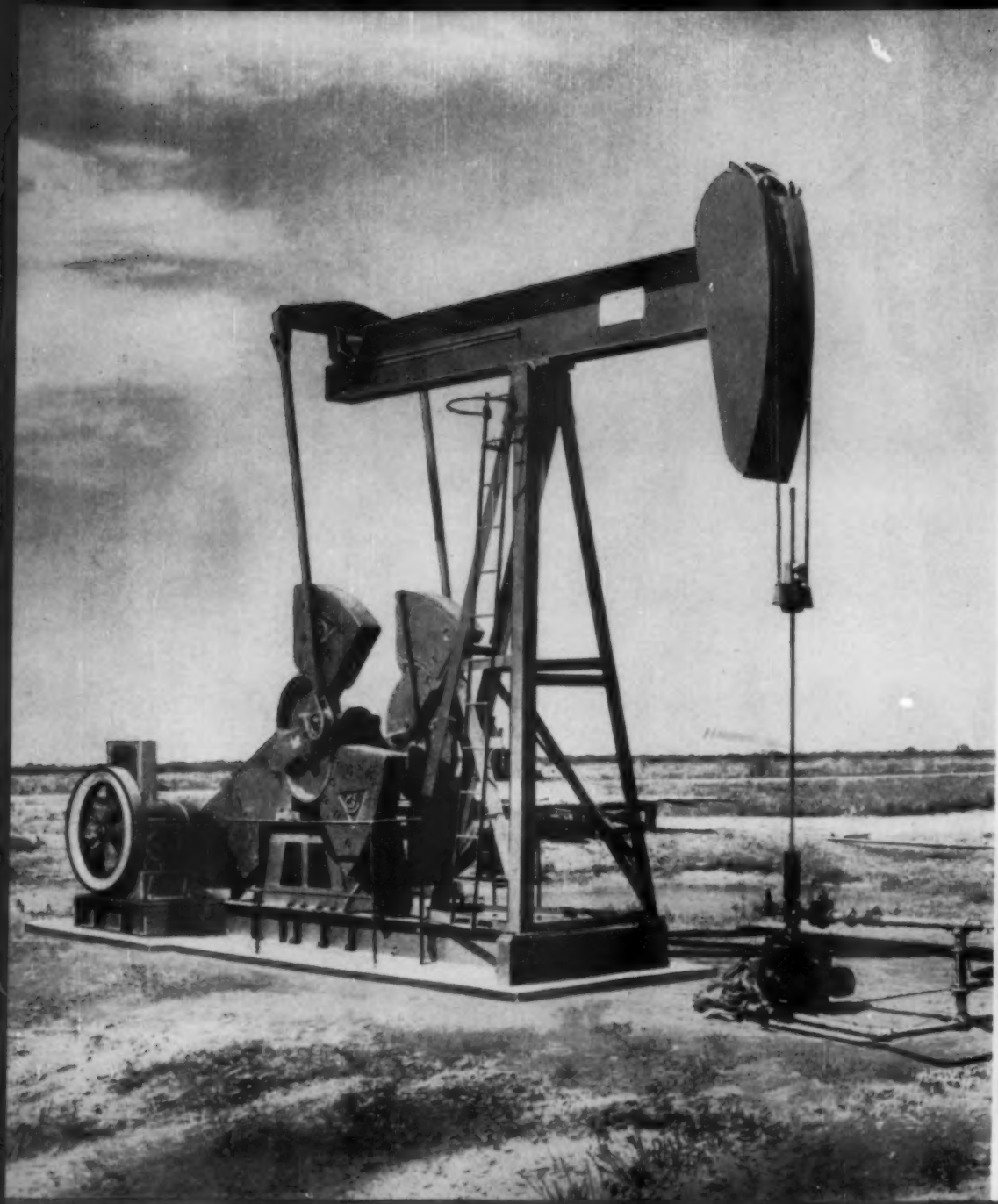

Step 1.
bolt .

Step 2.
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Step 3.
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Equipment

Lift Page
for Subsurface
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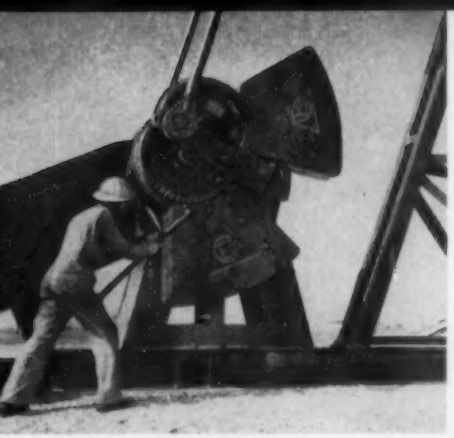
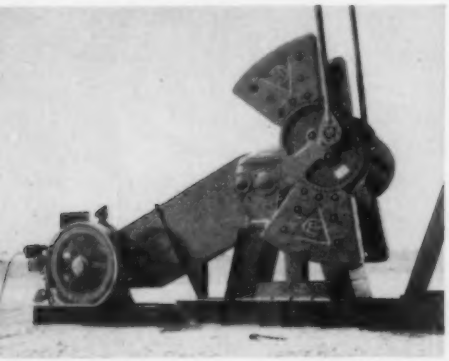
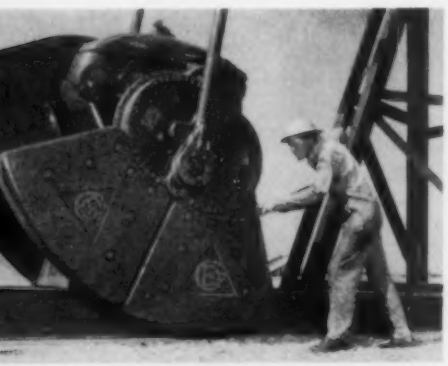


Step 1. With lower weight 15° off vertical . . loosen clamping bolt . . weight swings to vertical . . then tighten bolts.



Step 2. Disengage service brake . . stop other weight 15° off vertical . . loosen clamping bolts and tighten as in Step 1.



Step 3. Repeat operation until weights are swung into desired position.

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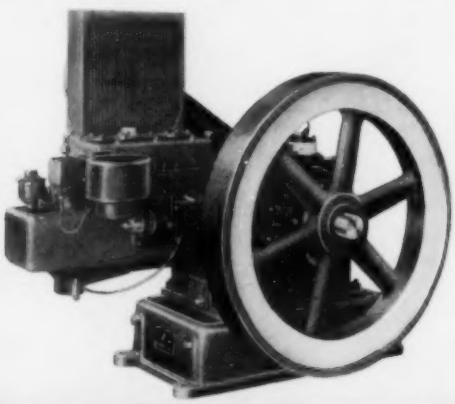

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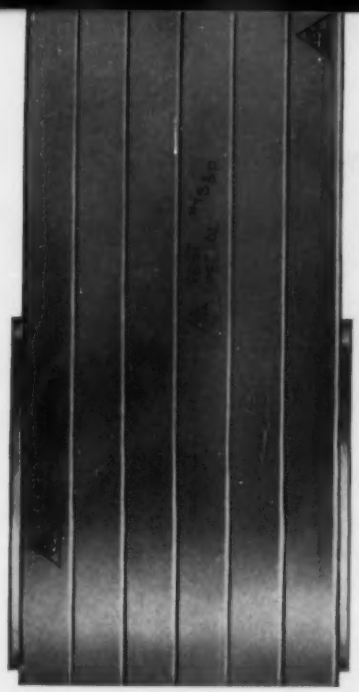

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AFROX* is an Aquaness product which removes invading water in air drilling by converting the water to a foam which can readily be lifted from the hole with normal compressor equipment. AFROX was successfully used in a series of field tests in Western Canada by Imperial Oil Ltd. Drilling proceeded with temporary water flows as large as 500 bbls./hr. Water flows of 70-100 bbls./hr. were successfully and economically combated by the use of AFROX.

Drillers have known for some time that air drilling offers many advantages in speed and bit life over conventional fluid drilling. One of the major problems in air drilling has been associated with the influx of water from aquifers and from water present in wet formations. The tests recently carried out by Imperial Oil Ltd. have shown that these difficulties can be overcome by the injection of foaming agents into the air stream. By use of this technique, the penetration rate advantages of air drilling can now be extended to formations which previously could not be drilled with air.

The tests are described on page 105 of the June 10, 1957 issue of The Oil and Gas Journal. Esso Research & Engineering Company have applied for a patent on this drilling technique. AFROX will be distributed through the facilities of Magnet Cove Barium Corporation, and those of the Baroid Division, National Lead Company. Additional information regarding AFROX and samples may be obtained by writing to Aquaness.

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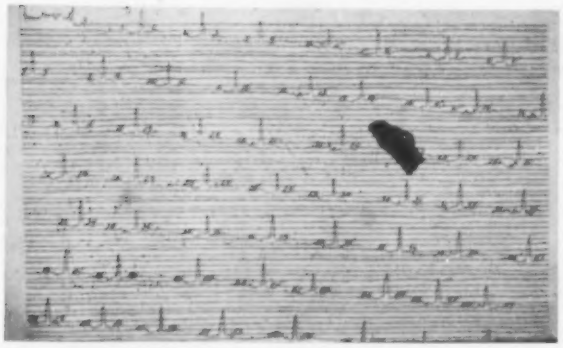
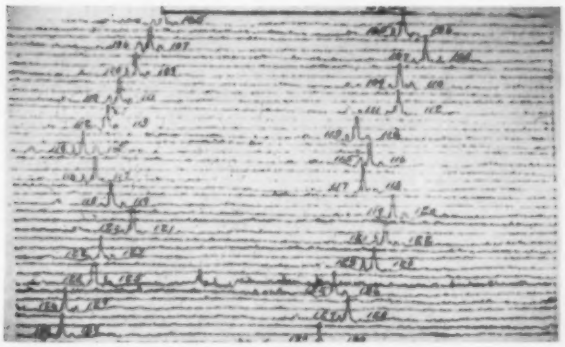
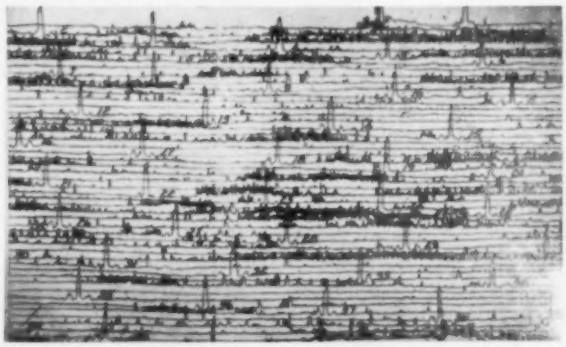


CALIPER SURVEY shows tubing from a well where visual inspection of surface connections indicated considerable corrosion damage.

DOWNHOLE DAMAGE was not indicated by visual inspection of surface connections. Surface coupons do not always give an accurate picture.



NEW TUBING has considerable surface irregularity. This shows the importance of an early survey so that corrosion can be detected later.



SEVERE CORROSION shown by this caliper survey might not leave any tubing to worry about if corrective measures were not taken soon.

How to Measure Rate of Corrosion in Tubing

. . . Inhibitor effectiveness should be checked often

By F. L. Rhoades, Jr.
Otis Pressure Control, Inc.

THERE are very few, if any, wells which can be produced without having some corrosion damage occur in the tubing. In some instances, the corrosion may be so slight, that by the time the reservoir is depleted, the tubing has not required inhibiting or replacement. In other cases, the corrosion may be so severe that internally coated and inhibited strings will have to be replaced several times.

To produce wells safely and economically, you must measure the extent of this corrosion damage to determine the useful life of the tubing and the inhibitor effectiveness. Tubing which will not hold well pressure can be costly and dangerous. Reservoirs have been seriously damaged or depleted by feeding into upper sands through ruptured tubing.

The cost involved in fishing and pulling tubing in small pieces could pay for many years of corrosion prevention and survey work. Also, time spent on fishing is lost production which cannot be regained. So, it is up to the corrosion engineer, the petroleum engineer, or anyone involved in production to show his management that a few cents spent in corrosion work now, is actually dollars saved later on.

In speaking of measuring corrosion, there are actually two types of measurements to be made: (1) rate of corrosion, and (2) actual corrosion-damage measurement.

Rate of Corrosion

In measuring the rate of corrosion, there are several methods used:

1. Tubing failure . . . When tubing fails, you have a very accurate record of the rate of corrosion. Some operators still wait until they can't bleed the pressure off the casing in a well with a packer before they decide to pull the tubing.

2. Iron content in produced fluids . . . This test, if accurately and periodically made, gives some indication of the rate of corrosion. However, it is more valuable as an indicator or evaluation of inhibitor effectiveness. The iron-content test has been questioned as

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TUBING MAY BE PULLED and inspected visually by . . .

. . . INSPECTION TOOL consisting of light behind a tilted mirror.

Types of measurement . . .

"In speaking of measuring corrosion, there are actually two types: (1) rate of corrosion, and (2) actual corrosion-damage measurement."

the accuracy of the results that are obtained. When an inhibitor is used, generally there will be a decrease in iron content in the produced water, and an increase in the iron content of oil produced. So, both phases have to be checked.

3. Coupons . . . When used on the surface in downhole installations, these give fairly accurate results as to the corrosiveness of produced well fluids. In the case of coupons, you are actually only measuring the rate of corrosion of a piece of metal other than the tubing. Consequently, the resulting rate obtained is a relative figure to be compared against the corrosiveness of produced fluids of other wells.

4. Corrosion meter . . . This test probe (actually it is a coupon) also will give accurate indications of the corrosiveness of produced well fluids. The advantage of the corrosion meter over regular coupons is the short test period needed to obtain results. One operator is planning to lower a probe into some gas-lift wells to check corrosiveness of well fluids at various depths.

5. Internal tubing caliper surveys . . . The previously mentioned measurements are actually only indicators of rate or possible rate of corrosion. As long as the tubing is in the well, the only positive method of measuring the actual rate of corrosion of the tubing is by two caliper surveys, made at a proper interval of time. This proper interval can be determined by iron content, coupons or an actual caliper survey. In an extremely corrosive well an accurate rate may be determined in 3 months. In other cases, when the well fluids are less corrosive, the surveys may have to be spread longer—6 months, a year, or even 2 years.

To calculate the life expectancy of tubing before it fails is important. Or, when measuring rate of corrosion to evaluate inhibitor efficiency, you should set up a definite program and carry it through.

Corrosion Damage

There are several methods for measuring the actual corrosion damage:

1. Internal tubing caliper survey . . . The simplest and most economical method of measuring corrosion damage to a string of tubing is made with a caliper survey while the tubing is in the well. This can be done with a mechanical measuring-mechanical recording instrument. Due to design and construction, the caliper records only the deepest pit when the feelers move into a corroded section of tubing. This recorded profile is used to determine corrosion damage. Individual pit depths can be measured, and from the pit depths, per cent reduction in wall thickness can be determined.

Tubing has been cut open and compared to the caliper survey by measuring the pits with a depth gage. The feelers do not enter all the pits; this could be accomplished only by having an infinite number of feelers. But, all of the pits measured by the feelers have been found to be accurately recorded. The caliper survey is used widely to cull corrosion-damaged tubing when the string is to be pulled.

Another instrument, a mechanical-measuring, electric-recording caliper may be used. This caliper records remaining wall thickness when the feelers move outward and make electrical contact with a gage ring. Successive runs are made to record several ranges of remaining wall thickness. This instrument is used more for checking rod wear than corrosion damage.

2. Visual inspection . . . The tubing can be pulled and inspected visually. Since it is almost impossible to see inside the full length of the joint, it is best to use the mechanical-optical inspection tool for this. It has a light behind a mirror which is set at an angle so the operator can check all of the inside surface. Tubing inspected like this can be salvaged for future use.

3. Destructive measurement . . . The joints can be cut open and each pit measured with a depth gage. This is about the only method that can be used to give you an exact picture of every joint and each pit in the joints. However, this is done seldom except to check on previous measurements from other methods.

THE AUTHOR

Frank L. Rhoades, Jr. has been with Otis Pressure Control, Inc. since 1953 when he went to work for that firm as sales engineer for Southwest Texas. He remained in Southwest Texas for about 2½ years and was sales engineer in South Louisiana for a short time. At present he is caliper engineer for Otis in Louisiana and Mississippi. Most of the 4½ years he spent as a petroleum engineer in South Louisiana was doing gas-supply work, well-testing, and well-completion work.

by W. L. Nelson
Technical Editor

COST-imating

Still More Inflation

WHEN either materials costs or labor costs lead each other, inflation occurs. Wage increases sparked a rise in materials costs during 1954 and 1955, and now the increases in materials costs during late 1955 and 1956 appear to have called for another increase in wages, as see the attached tabulation of percentage increases by quarter since 1953:

	Labor				Material			
	1954	1955	1956	1957	1954	1955	1956	1957
First quarter	0.5	zero	0.9	1.0	—2.0	—1.8	2.1	0.5
Second quarter	1.55	1.55	2.1	—	0.9	zero	0.6	—
Third quarter	1.4	1.4	1.3	—	1.3	5.55	5.0	—
Fourth quarter	0.4	0.4	0.3	—	—0.3	1.1	0.3	—

The cost indexes on the page may be used to convert prices known at any date to prices at other dates or the present, by ratios of the cost indexes of the same dates. Similar itemized cost indexes are published quarterly in the first weekly issues of January, April, and October. In addition, the Nelson Refinery Construction Cost Index is published in the first issue each month of The Oil and Gas Journal in the Engineering Section.

Itemized Cost Indexes

(Multiply the 1946 prices of the COST-imating Series by these Index Numbers divided by 100)

	1949	1952	1954	1955	1956	March 1957	References*	Index for earlier years (The Oil and Gas Journal) in Cost-imating issues
Labor:								
Skilled construction	133.9	157.9	174.6	179.8	187.3	192.3	Eng. News Record	No. 55—Nov. 3, 1949
Common labor	140.4	168.2	192.1	199.4	209.2	214.9	Eng. News Record	No. 55—Nov. 3, 1949
Refinery construction	137.1	163.1	183.3	189.6	198.2	203.6		No. 61—Dec. 15, 1949
Refinery operation	132.9	155.1	169.5	176.7	188.7	190.0	Sur. of Current Business	No. 55—Nov. 3, 1949
Refinery productivity, bbl. per employe	125.0	132.0	142.0	149.0	146.1	149.5	Sur. of Current Business	Sept. 24, 1956
Equipment or Materials:								
Arc-welding machinery	130.5	151.3	158.4	163.8	180.2	185.4	Code ‡11-76	May 2, 1955§
Boilers, tanks, and sheet metal	†134.8	†153.4	147.3	150.3	168.0	177.8	Code 10-72	April 21, 1952§
Boiler tubes, 2-2¼ in.	140.9	168.8	199.4	211.2	235.5	257.7	Code 10-14-61	Sept. 5, 1955§
Building materials (nonmetallic)	151.2	134.8	143.6	149.4	154.0	158.2	Code ‡13	No. 22—Mar. 17, 1949
Brick—building	127.7	140.6	144.7	150.5	159.2	161.1	Code 13-41	No. 20—Mar. 3, 1949
Brick—fireclay	139.8	167.1	193.1	205.9	218.1	223.6	Code 13-42	May 30, 1955§
Castings (foundry products)	150.5	168.0	181.1	185.1	204.7	216.2	Code 10-15	No. 46—Sept. 1, 1949
Clay products (structural, etc.)	126.0	145.8	159.1	167.4	176.9	180.2	Code 13-4	No. 20—Mar. 3, 1949
Concrete—ingredients	123.7	132.7	142.1	146.6	153.3	158.6	Code 13-2	No. 22—Mar. 17, 1949
Concrete—products	121.7	132.6	138.5	139.8	144.9	148.2	Code 13-3	
Electric machinery	130.9	152.4	159.9	162.5	175.0	186.9	Code ‡11-7	May 2, 1955§
Motors and generators	128.7	154.6	157.7	157.1	169.6	180.0	Code ‡11-73	No. 31—May 19, 1949
Switchgear	132.3	161.4	171.2	176.5	194.9	208.3	Code ‡11-75	May 2, 1955§
Transformers	129.7	148.0	161.9	161.8	175.4	186.3	Code ‡11-74	No. 31—May 19, 1949
Engines (composite)	124.8	146.5	150.5	153.2	164.0	173.3	Code ‡11-54	No. 36—June 23, 1949
Exchangers	133.0	165.8	174.5	156.8	193.4	195.9	Manufacturer	No. 2—Oct. 28, 1948
Fans and blowers	152.2	183.7	192.6	199.7	222.4	235.8	Code 11-47	Feb. 17, 1949§
Hand tools	134.0	155.1	173.8	185.7	200.3	211.8	Code 10-42	June 27, 1955§
Instruments (composite)	126.1	146.2	154.6	162.9	182.1	186.2	Manufacturer	No. 34—June 9, 1949
Flow meter (mechanical)	109.2	132.3	161.6	177.2	203.3	203.3	Manufacturer	No. 34—June 9, 1949
Flow meter (air control)	132.4	160.5	179.6	188.6	203.9	208.2	Manufacturer	No. 34—June 9, 1949
Flow meter (remote)	130.2	155.2	146.5	153.5	170.2	170.2	Manufacturer	No. 34—June 9, 1949
Potentiometer, 6-point	125.8	151.5	167.2	178.6	211.8	229.1	Manufacturer	No. 34—June 9, 1949
Potentiometer, air control	131.6	144.9	150.5	164.0	192.3	202.7	Manufacturer	No. 34—June 9, 1949
Pressure controller recorder	130.2	158.4	166.3	169.1	187.1	187.1	Manufacturer	No. 34—June 9, 1949
Pressure gage	100.0	108.6	108.6	112.1	119.2	119.2	Manufacturer	No. 34—June 9, 1949
Thermometer (recording)	118.6	149.4	152.8	156.5	170.2	170.2	Manufacturer	No. 34—June 9, 1949
Control valve	129.8	155.5	162.0	166.8	180.9	185.5	Manufacturer	No. 34—June 9, 1949
Lumber (composite)	165.3	203.2	197.8	209.7	214.5	204.3	Code 8-1	No. 7—Dec. 2, 1948
Southern Pine	157.7	191.2	181.2	188.4	195.0	189.1	Code 8-12	No. 7—Dec. 2, 1948
Other soft woods	203.9	248.5	252.7	265.1	266.5	258.3	Code 8-13	No. 7—Dec. 2, 1948
Machinery—general purposes	131.9	151.8	159.9	166.8	183.8	194.4	Code 11-4	Feb. 17, 1949§
Machinery—construction	136.0	157.5	165.9	172.5	187.4	197.6	Code 11-2	
Machinery—oil fields	†132.9	†149.9	†161.9	†168.5	†179.3	†187.3	Code 11-51	Oct. 10, 1955§
Paints—prepared	142.8	155.7	159.0	161.4	169.2	175.0	Code 6-21	May 16, 1955§
Pipe, sewer	†119.3	136.9	140.1	149.9	160.5	167.8	Code 13-45	No. 22—Mar. 17, 1949
Pipe, black iron	152.2	179.0	195.0	204.0	233.0	250.7	Code 10-14-56	No. 19—Oct. 15, 1956
Pipe, 6-in. line	†152.0	†174.0	†200.5	†211.8	†241.2	262.9	Code 10-14-58	May 4, 1957§
Pumps, air compressors, etc.	135.9	155.6	166.5	177.2	192.0	203.3	Code ‡11-41	No. 29—May 5, 1949
Steel (iron and steel)	143.3	168.5	179.6	189.9	209.0	221.3	Code 10-1	No. 61—Dec. 15, 1949
Steel—finished steel	173.8	170.0	187.1	196.0	212.4	227.8	Code 10-14	July 25, 1955§
Plate	142.1	163.1	187.0	195.1	215.9	239.1	Code 10-14-26	Mar. 4, 1957§
Structural shapes	152.2	176.2	193.4	204.3	219.1	246.7	Code ‡10-14-31	No. 18—Feb. 17, 1949
Valves and fittings	†132.9	190.8	197.1	208.6	231.9	241.2	Code ‡11-49 (1-6 and 11-14)	No. 46—Sept. 1, 1949
Nelson Refinery Construction	139.6	163.6	179.8	184.2	195.3	201.8		No. 61—Dec. 15, 1949

*Code refers to the revised index code number of the Bureau of Labor Statistics, U. S. Department of Labor, "Wholesale Prices." †Estimated base value for 1946. ‡Not exactly the same items as those published before July 7, 1952. §Questions on Technology, The Oil and Gas Journal. †Preliminary.

By W. L. Nelson
Technical Editor

QUESTIONS ON TECHNOLOGY

History of Light-Oil Treating Processes

There are so many treating processes that it seems that obsolescence must be much more rapid in this field than in crude-oil processing (your question of May 20, 1957).—R.F.C.

Although numerous names of treating processes have of late been offered, many of these are only modifications of a general method or of older methods. In fact, the original method of decreasing the sulfur content, namely the use of sulfuric acid, was not displaced until the last few years (hydrodesulfurization 1954) except in a few plants which employed sulfur dioxide extraction. Throughout a long period (1888-1925) the Frasch copper oxide process was used for desulfurization.

Likewise, the original (1910) lead plumbate or doctor sweetening process is still in use today although sodium hypochlorite was once extensively used (1918-1936) and since about 1928 much sweetening has been accomplished by the copper chloride process. The deleterious effect of very small amounts of sulfur compounds on the antiknock properties of leaded fuels became particularly important after about 1935 and since that date a large number of processes have been developed by which such sulfur compounds can be eliminated without destroying the main bulk of the hydrocarbons in the gasoline (see Table 1).

Finally, the recently developed inhibitor sweetening process promises to become standard practice in the handling of very much cracked gasoline. Refinery processing is now so complete that we need a large number of treating processes, each selected upon its merits for the particular job at hand.

Evaluation of Treating Processes

Sulfuric acid treating seems to have been used since the earliest days of the refining industry. This was followed shortly (1880) with the rerunning of distillates that were too yellow in color. When the high-sulfur oils of Ohio and Indiana were discovered (1886) something had to be done about sulfur, and the Frasch process of copper oxide treating which was already known, was employed. It is a surprise to most technical men to learn that the Frasch process was still discussed in the literature in 1923 *(The Oil and Gas Journal, May 3, 1923, page 127)* for the handling of especially high-sulfur (Mexican) oils. The familiar doctor-sweetening process which is still used was known in 1910 but it was not used extensively until after cracked gasoline became a major product. Clay was used to a limited extent after 1912 in the decolorization of kerosine and its use persists today. By 1922, continuous treating systems were being used for doctor sweetening and by 1933 all new installations for acid treating, caustic washing, etc., were of the continuous type. Hypochlorite sweetening was used extensively during 1918-1936 especially in the treating of natural and straightrun gasoline.

Although sulfur dioxide extraction was practiced extensively in Galicia, Romania, Borneo, and India after 1912 for the removal of aromatic hydrocarbons and sulfur from kerosine, the first installation in the United States was in California during 1924. Clay vapor-phase treating was used for cracked distillates after about 1925 but its development was halted by the introduction of gum inhibitors (1928). Inhibitors and the use of dyes is still the common practice. Copper chloride sweetening was investigated during 1926-1928 and since 1935 nearly all new sweetening installations have been of this type. However, recent developments (since 1954) in the use of so-called inhibitor sweeteners may curtail the introduction of new sweetening plants for some years.

The Octane Race

Octane number has been increasingly important since 1940 and one of the first responses was the abandonment of acid treating (1932-1938) and the development of high-temperature (700° F.) clay or bauxite vapor-phase treating (1940). At the same time processes of caustic extraction of mercaptans with the aid of various solubility increasers were developed and some of these processes are still in use today. Finally, in about 1954 the use of catalytic agents on clay in the presence of hydrogen began to be installed for the hydrodesulfurization of straightrun and to some extent cracked distillates. For the first time, methods of reducing the sulfur content of materials boiling up to even 700° F. (hydrodesulfurization) appear to be economically feasible.

TABLE 1—CHRONOLOGY OF LIGHT-OIL TREATING

1870 (1855-)	Sulfuric acid and caustic neutralization
1896 (1888-1925)	Frasch copper oxide desulfurization
1890 (1880-)	Acid treating and rerun distillate
1915 (1910-)	Acid treating and rerun distillation
1915 (1910-)	Sodium plumbate sweetening
1922 (1912-)	Clay decolorization and stabilization
1922 (1916-)	Continuous doctor sweetening
1928 (1918-1936)	Sodium hypochlorite sweetening
1928 (1924-)*	Sulfur dioxide extraction of aromatics, etc.
1930 (1925-1938)	Gray vapor phase clay treating for gum
1931	Dyes for gasoline
1932 (1928-)	Inhibitors for gum
1933 (1916-)	Continuous treating systems for all agents
1935 (1928-)	Copper chloride sweetening
1940 (1935-1950)	High temperature clay desulfurization for octane number
1941 (1939-)	Caustic solutizer desulfurization for octane number
1954 (1947-)	Catalytic hydrodesulfurization
1956 (1954-)	Inhibitor sweetening

*Since about 1912 outside the United States.

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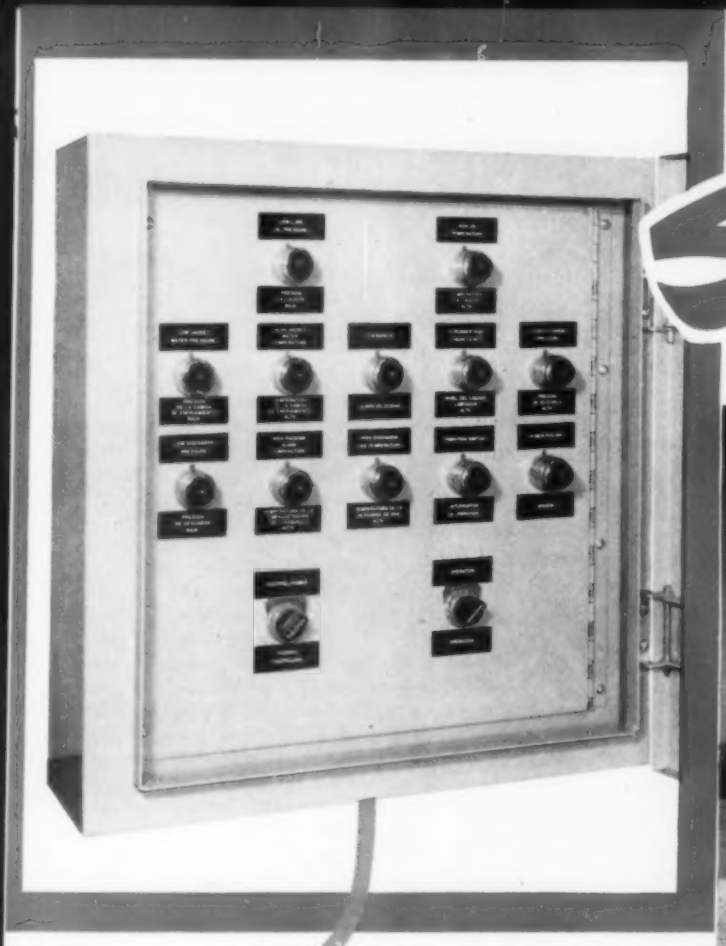

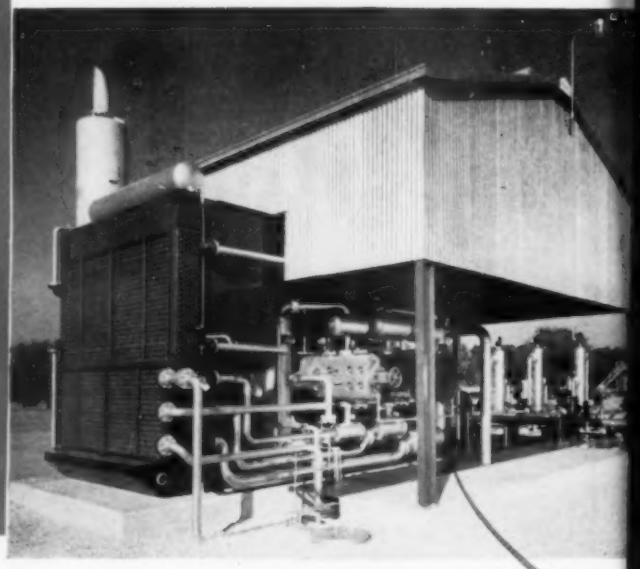

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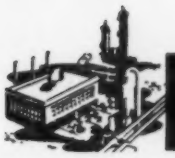
Fluid Flow
Part 5



JOB IMPROVEMENT FOR THE PROCESS FOREMAN—94

Valves and Fittings Affect Friction Loss

THE NUMBER of valves, the size and type, the number of ells, tees, and orifices all affect friction loss. However, the effect of various fittings can be predicted fairly accurately and therefore can be taken into account when designing pipelines for any particular system. The effect of these fittings is spoken of as equivalent lengths of pipe. In making the pressure-drop calculation, the equivalent lengths of pipe for each fitting is added to the length of the straight pipe. An idea of the effect of fittings upon the flow of fluid may be gained from Fig. 3a (Part 4, June 17) and Table 2.

TABLE 2—EQUIVALENT LENGTH IN FEET FOR EACH FITTING

Size of pipe (in.)	Standard elbow	Long-sweep elbow or std. tee	Wide-open position: Gate valve	Wide-open position: Angle valve	Wide-open position: Globe valve
1	1.7	0.8	0.6	2.3	5.1
2	4.0	2.0	1.5	5.4	11.9
3	6.7	3.3	2.5	8.9	18.7
4	9.2	4.5	3.4	12.4	27.5
6	21.7	10.7	8.1	29.2	64.8

Movement of fluidized solids . . . Fluidized solids are finely divided solid materials that behave as a liquid when aerated properly. The catalytic cracking units are good examples of fluidized solids operations. The compressed, solid fresh catalyst, with no voids between the particles, has a density of about 75 lb. per cu. ft. Each particle of catalyst contains many small pores.

Nonaerated, powdered catalyst, which has been allowed to settle in a container has voids of air or gas between the particles as well as in the pores. Its density is about 40-50 lb. per cu. ft.

By mixing more gas with the catalyst the density is decreased. When the density approaches 30-40 lb. per cu. ft., the catalyst becomes fluidized or acts like a fluid. In this state, gas films have formed around the particles decreasing the friction between them. The fluidized catalyst exerts a pressure at the bottom of the standpipe that is proportional to the height of the catalyst in the pipe and the density of the gas-catalyst mixture. Since the catalyst in the fluidized state behaves as a fluid, our future units which use a solid catalyst probably will be designed to take advantage of this feature.

This material taken from process-training-program manual, Baton Rouge, La., refinery of Esso-Standard Oil Co.

Pressure . . . It has been pointed out that a fluid tends to move from a high pressure to a lower pressure area. It has been pointed out also that in refinery operations, we often want the flow to be from a low to a high-pressure area. This requires the use of pumps or compressors.

In the operation of pumps, pressure drip is of the utmost importance. To operate a centrifugal pump, for example, the suction line can be and often is more important than the discharge line. Although the discharge line may be designed so the pump is capable of putting the required amount of liquid through it, if the suction line is not large enough or if improperly installed, pumping difficulties will be experienced.

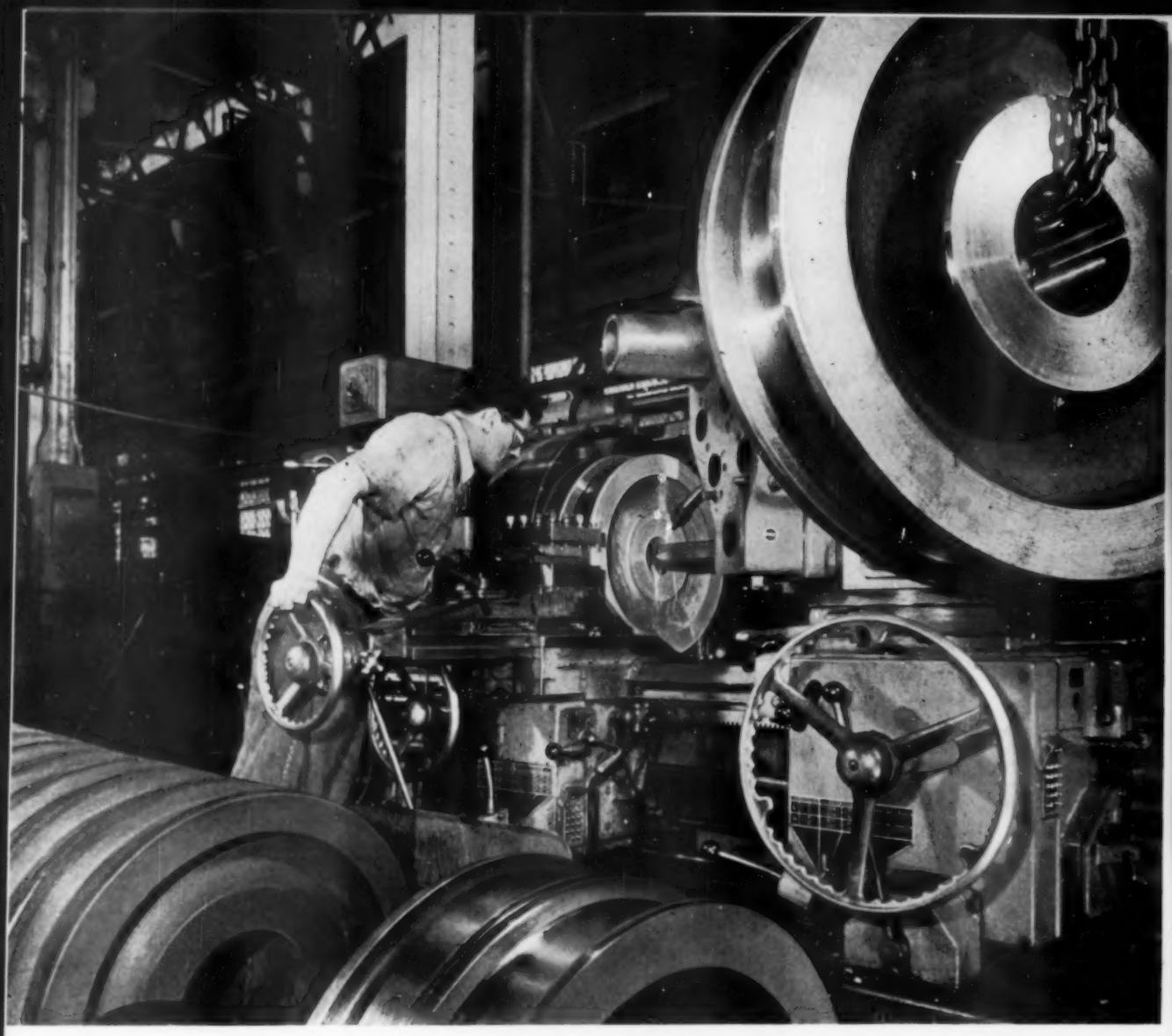
If the pressure drop is such that the liquid starts to vaporize when it reaches the pump or if suction conditions are not correct, then the pump will not fill properly and will become gas bound. The pumping rate and discharge pressure will fall off and the pump will begin to slip and heat up. This slipping will occur with either centrifugal or reciprocating pumps.

In determining the characteristics of the pump to be installed for a particular job, the suction pressure must be taken into consideration. For example, take a pump that has a suction pressure of 0 psig. and a shutoff discharge pressure of 200 psig. This same pump when taking suction from a vessel operating at 100 psig. would have a shutoff discharge pressure of 300 psig. If the pump were discharging into a system that was good for only 250 psig., this pump could not be used without installation of a safety valve.

Fluids performing work . . . We have discussed the behavior of fluids when work was being performed on them. Now we will cover how fluids can do work. The fact that a liquid exerts pressure due to its density has been discussed. It was pointed out that a column of water would exert a pressure of 0.433 lb. per sq. in. for each foot of height. Suppose we built a dam and raised the height of the water to 200 ft. That would mean the pressure at the bottom of the dam would be 0.433×200 or 86 lb. per sq. in. This says that if turbines were installed at the bottom of the dam we would have a driving force of 86 lb. per sq. in. to turn the turbines. The water turbines then furnish the power that operates the electric generators for supplying electricity to the surrounding area. This is the principle on which the larger power dams work. In other words, fluids can be harnessed to do work.

The first four parts . . .

Part 1—How Fluid Flow Affects Refinery Operation, May 27, p. 153.
Part 2—Determining the Viscosity of a Fluid, June 3, p. 124.
Pare 3—Specific-Gravity Variations, Types of Flow, June 10, p. 126.
Part 4—Resistance of Valves and Fittings to Fluid Flow, June 17, p. 124.



Thirty-Ton Cranes Will Roll on These Sturdy Wheels

This is a part of the machine shop of Industrial Crane & Hoist, Ingersoll Products Division, Borg-Warner Corporation, Chicago. Those big double-flange wheels, weighing 408 lb each and made from Bethlehem's tough, rugged circular forged blanks, will be used on bridge cranes that the company manufactures. The cranes have a capacity of thirty tons.

Obviously, strength is the first requirement that the wheels have to meet. Another is durability (flanges and tread must be long-wearing). Still a third is overall quality to match that of other components in the big cranes.

The wheels score a bull's-eye on every count, for the husky Bethlehem blanks from which they are made are both forged and rolled in a single operation—a unique process that insures high strength and a well-forged structure throughout.

Bethlehem blanks have many applications in addition to crane wheels. They are widely used for spur, bevel, and herringbone gears; flywheels, sheave wheels, and industrial wheels; turbine rotors, pipe flanges, and many other circular products. Available in a wide choice of sections, the blanks range in size from 10 to 46 in. OD. They can be furnished heat-treated or untreated.

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By Robert L. McIntire
The DATICS Corp.

Using Electronic Computers in the Oil Industry — Part 13

Calculating Flash Temperatures

IN a previous article in this PETROdatics series, the isothermal-flash-vaporization problem was discussed and block diagramed.[1] The inverse of this solution is required when the per cent vaporization of a feed is given. Then the temperature required to accomplish the given amount of vaporation must be computed. This new problem is only slightly more complicated than the isothermal-flash problem. The complicating feature is that the computer must have access to equilibrium data for each component over the entire possible temperature range.

These data are stored in the computer either in a curve-fitted form or in arrays of tabular information. The merits of each method have been discussed previously.[2] For convenience, let us consider here that the data are stored as constants in the following equation:

$$\ln K_i = A_i + B_i T + C_i T^2 \quad (1)$$

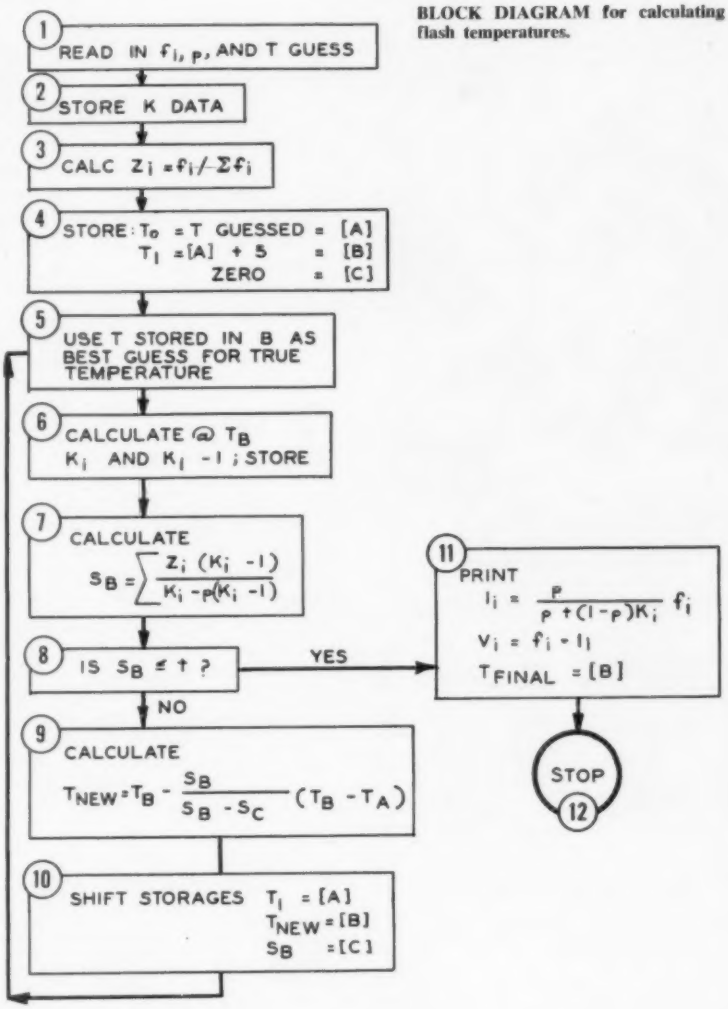
Thus, if we are considering a flash for a 20-component stream, a total of 60 storage locations in the memory of the machine will be used to store the K data.

Equation 2 is the expression which must be made equal to zero by choosing the correct value of temperature.

$$S = \Sigma \frac{Z_i (K_i - 1)}{K_i - p (K_i - 1)} = 0 \quad (2)$$

The fraction of the feed which is liquid, p, and the mole fraction of each component in the feed, Z_i, are constant. As new values of temperature are chosen, new K_i values are tried in Equation 2. Thus, each such assumed temperature will yield a new value of the summation, S. To complete the procedure, we need an iteration equation which selects a new assumption for temperature such that the calculated summation, S, will be minimized.

The Newton method or, more simply, the straight-line extrapolation method, is used in block 9 of the block diagram. By this method, two assumptions of temperature are made and their corresponding summations, S, are computed. The routine provides that the most recent pair of results will be used to make the next prediction.



BLOCK DIAGRAM for calculating flash temperatures.

The one outstanding criterion of a good machine routine is that it should satisfy the general case. The engineer[3] who brought the coding of this problem to the author's attention was justifiably proud of the fact that the routine could be used for calculating bubble points and dew points. Simply by setting the value of p to either zero or one, the corresponding extreme condition can be computed.

References

1. McIntire, R. L., PETROdatics Part 11, "Isothermal Flash Calculations," The Oil and Gas Journal, page 158, May 27, 1957.

2. McIntire, R. L., PETROdatics Part 5, "Computer Storage of Enthalpy and Equilibrium Data," The Oil and Gas Journal, page 122, March 4, 1957.

3. Driscoll, M. J., ensign, United States Navy, private communication.

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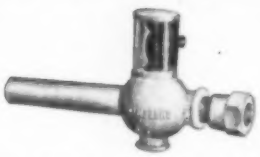

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Among the Drilling Contractors

New Drilling Firm Formed In Three-Company Merger

Merger of Louisiana Offshore Drilling Co., Delta Offshore Drilling Co., Inc., and D. E. Vasser, Inc., into a newly formed corporation, Louisiana-Delta Offshore Corp., has been announced by Alvin H. Howard, chairman of the board and vice president.

The new organization, as have its predecessors, will maintain headquarters at New Orleans, and will continue to engage in contract drilling operations in tideland waters off the Gulf Coast, and in inland water beds of bays and marshes adjacent to the coast.

It has two submersible drilling barges in operation, and a third under construction. Operating rigs include its $1,950,000 California Co. S-45 drilling barge capable of going to 20,000 ft. and working in water 25 ft. deep. The other is its $448,000 Jett barge capable of drilling to 14,000 ft. and working in 10 ft. of water.

Under construction is its $3,700,000 Louisiana barge capable of drilling to 20,000 ft. and operating in 67 ft. of water.

Officers of the company, in addition to Howard, are Dave E. Vasser, president; Pickard, New York City, vice president; John P. Labouisse, secretary-treasurer; Henry A. Broughton, superintendent of operations; and D. A. Mardis, Jr., assistant secretary. All except Pickard, of New York City, live at New Orleans.

Richardson & Bass have contract for a 16,000-ft. well in Bayou Penchant, Terrebonne Parish, South Louisiana, for Superior Oil Co. The A-6 La Terre Co., Inc., will be drilled in 11-19s-13e.

Columbian Drilling Co. will drill a well in East White Lake field, Vermilion Parish, South Louisiana, for Union Oil Co. of California. The 1 Leo Mixon et al. is in 10-15s-1e.

Bankhead Drilling Co. has contract for a 7,000-ft. well in White Castle field, Iberville Parish, South Louisiana, for Shell Oil Co. The 11 Forest Home is in 2-11s-12e.

Douglas Drilling Co. has contract for a 3,400-ft. well in North Cankton field, St. Landry Parish, South Louisiana, for Drew Cornell, Inc. The 1 Mrs. Amite LeBlanc is in 40-8s-4e.

Grey-Wolfe Drilling Co. is contractor for a 11,000-ft. well in Lake Arthur field, Jefferson Davis Parish, South Louisiana, for C. H. Lawrence, Jr., and Texas Eastern Trans. The 1 Strobe et al. is in 15-10s-4w.

B. F. Allison is contractor on four Denver basin wildcats for Allstate Oil Corp. All four are located in Wash-

ON A DEEP DRILLING RIG Clegg & Hunt, Houston contracting firm, has been operating for Cyprus Oil Co. in the Bauer Ranch area, 8 to 9 miles south of Nome, in western Jefferson County, Texas Gulf Coast. Left to right: H. R. Sims, tool pusher; W. A. Roska, driller; and E. J. Hudson, D. W. Tate, D. R. Thomas, and W. B. Ryan, crewmen. Picture was taken on Cyprus' 2 Lohman-Howth, on the south end of production, which was completed at total depth of 9,768 ft. Above contractors have drilled 11 wells for Cyprus in the immediate Bauer Ranch area. Discovery well was completed in February 1955.

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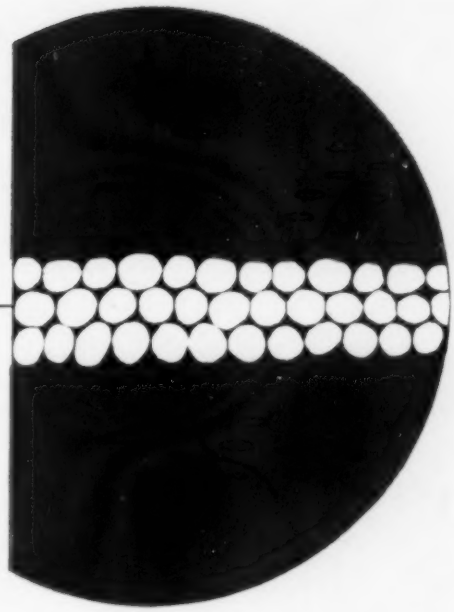

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- Difference in grain sizes must be small . . . for maximum packed permeability and uniform supporting action.
- Grain diameter must be the largest practical for the formation being fractured.
- Compressive strength must be high, to minimize crushing under formation load.
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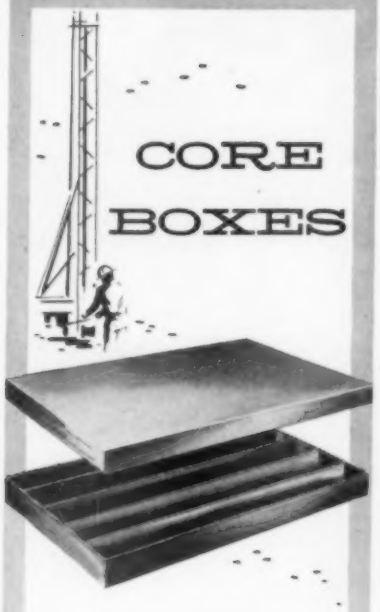

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ington County, Colorado. The tests are: 1 Holtorf, C NE NE 2-4n-52w, 1-7 Armour, C SW NW 7-5n-52w, 1-18 Armour, C SE NE 18-5n-52w, and 1 Colorado A&M College in C SW SE 20-5n-52w.

Crow Drilling & Producing Co., Shreveport, has contract for 5,900-ft. Mitchell sand test for Gulf Oil Corp. at 1 A. W. Friend et al in 9-19s-25w, northeast offset and confirmation try to Walnut Hill field in Lafayette County, southwestern Arkansas. The discovery well, 1 Maryman, flowed 114 bbl. of oil per day and 13 bbl. water on 10/64-in. choke from perforations in the Mitchell sand at 5,833-37 ft. That well is in NE¼ 16-19s-25w.

Offshore Drilling Co. has contract for The California Co.'s 11,000-ft. wildcat in St. Charles Parish, west of Kenner field in South Louisiana. The 1 Arthur Craft et al Unit 1, 40-12s-9e, is north 80 degrees 26 minutes west 250 ft. from USC&GS Station "Almedia-1929."

Penrod Drilling Co. has contract for a 14,000-ft. wildcat in Calcasieu Lake, Cameron Parish, South Louisiana, for Hunt Oil Co. of Dallas. The 1 State Lease 2402 will be in 14s-9w.

Miller Drilling Co. has contract for a 13,000-ft. wildcat in south-central Chaves County, New Mexico. The test will be H. W. Etz, Jr. 1 Allison et al. Location is 15-14s-25e, 20 miles northwest of High Lonesome field. There is no nearby production.

Fortune Drilling Co. has contract for Murphy H. Baxter 1 Small, a 7,000-ft. wildcat 4 miles northeast of Tankersly in western Tom Green County, West Texas. Nearby production is Bubenik-Pennsylvanian field, 2½ miles south.

Maxwell Drilling Co. was moving in tools last week at W. B. Osborn 1 H. L. Curtis, 3,500-ft. rotary wildcat 14 miles northeast of Brady in McCulloch County, West Central Texas.

Gardner Bros. Drilling Co. was drilling ahead at Gulf Oil Corp. 1 Fasken Operating Area, located 15 miles north of Odessa, in Ector County, West Texas. Projected depth is 14,500 ft. Location is in Section 18, Block 42, Township 1 North, G&MB&A Survey.

Miracle-Fifer Drilling Co. has contract for a San Juan basin wildcat in San Juan County, northwestern New Mexico. The well is Sinclair Oil & Gas Co. 1 Texas-National in C NE NE 25-23n-6w. Drilling was below 868 ft. at last report.

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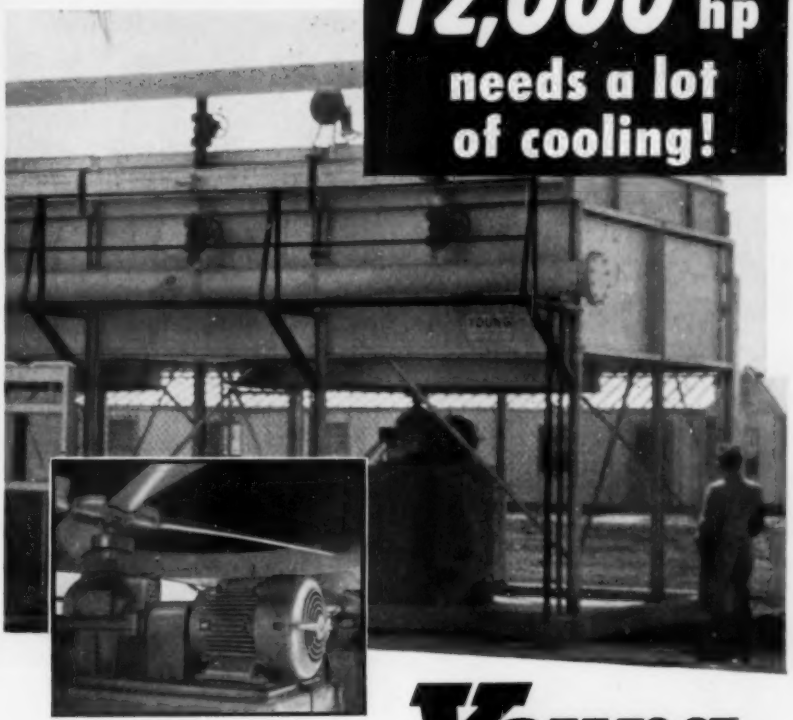

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U-1091	6	LPG	269 @ 1,600 rpm
		Nat. Gas	247 @ 1,600 rpm
Complete Power Unit With Radiator and Fan			
UDT-1091	6	Diesel	250 @ 1,500 rpm
UD-1091	6	Diesel	200 @ 1,500 rpm
U-1091	6	LPG	255 @ 1,600 rpm
		Nat. Gas	232 @ 1,600 rpm

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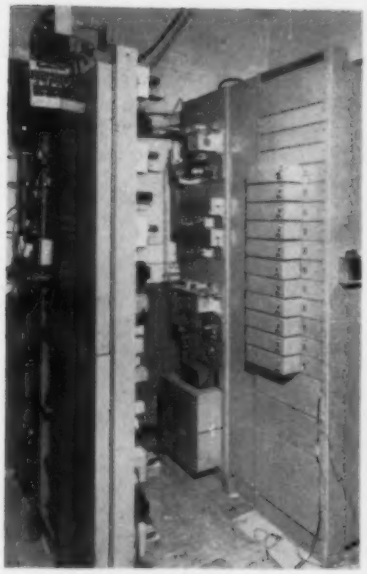
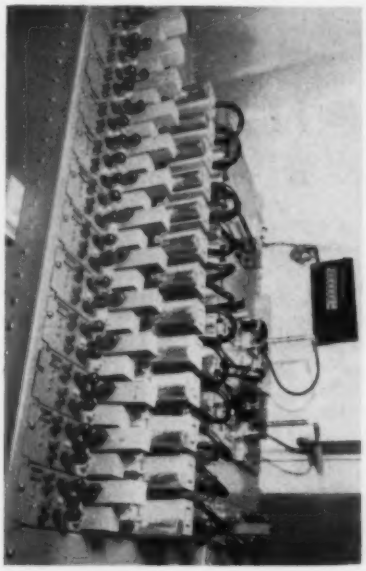


NEW multiplex rack shown at right.



REAR VIEW of channel components.

Microwave facilities expanded as . . .

Quadriphase doubles network capacity

By Larry Resen
District Editor

MICROWAVE facilities on Transcontinental Gas Pipe Line Corp.'s network have been expanded to provide facilities for 25 channels between Houston, Tex., and Linden, N. J.

This doubling of channel capacity was achieved through modification of existing equipment and installation of new "Quadriphase" multiplexing equipment manufactured by General Electric Co.

Installation of the new facilities required an elaborate testing program and carefully planned cutover procedure to insure against disruption of service when the new equipment was placed into operation.

How it began . . . With an increase of pipeline capacity and a fairly constant expansion program, Transco found its previous microwave system becoming inadequate to handle the increasing demand for both talking time and operational requirements. Ten of 12 channels were in operation on the network, and the addition of the two channels available would only partially ease the overloading of the system.

The high demand for microwave service was on the northern sector of the system. The facilities between Houston and the stations south to the origin of the line in the Rio Grande Valley are adequate.

A decision was made to expand beyond the 12-channel limitation on the northern sector. New type of multiplexing equipment developed by G.E. made it possible to expand to a 25-channel capacity and use much of the existing equipment.

Quadriphase . . . In the existing equipment on the system, the master timing or synchronization required complex wave forms which required very precise and very stable plate and bias voltages. These were sometimes difficult to achieve 100 per cent of the time under operating conditions. The timing was based on a precise crystal oscillator, adjustable countdown circuit, timer pips, regulated voltages, and sawtooth wave form from which was derived the sync pulse or separate channel pulses.

Many variables could affect the operation of the system. The timers or sawtooth voltages could vary with the plate or bias voltages and the sync pulse would vary as well as the selective position of the various pulses. The situation is more critical whenever a multichannel system is pushed to its ultimate performance or by simultaneous and continuous loading of a high percentage of the channels.

The quadriphase system was the result of a new approach to the synchronization problem. Simplicity of design, operation, and maintenance was a prime requisite. The system uses the sine wave as the simplest wave form and the resistor and condenser as the least expensive and most trouble-free component to form the heart of its operation.

The theoretical aspects have been fully discussed in the literature.[1,2] In short, however, a single sine wave is phased into two waves phased exactly 180° apart. Each of these is then shifted 90° to obtain four sine waves of exactly the same frequency and phased in quadrature, hence quadriphased.

With the four sine waves as a master timing signal, it is possible to use networks containing only resistors and a condenser to form a sine wave of any desired phase. Only a very small portion of the sine wave in the immediate vicinity of the zero axis will be used for the actual timing of the channel pulses.

The amplitude of the quadriphase voltages is not critical and regulated plate voltage is not required in any part of the system. The receivers are synchronized with the original sine wave and will shift with it. The net result has been a system with few tubes, simple to adjust, a high degree of stability and requiring fewer man-hours of maintenance.

Modifications . . . A great deal of preliminary work was done on the existing system to prepare it for the new facilities. Modifications had to be made on all existing transmitters and receivers plus power supplies at 22 stations to make them compatible with the new equipment. In addition, radio frequency gear at 28 repeater stations had to be modified.

New type of selector switches had to be installed at the 22 main microwave stations. To speed testing and the final cutover to the new facilities, the existing multiplex units were tied into terminals on the selector switches which wouldn't be needed after the cutover. New audio wiring was also

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tied in but held dead for the new multiplex units.

The new multiplex units were installed at all of the stations and the testing period began. These tests required the physical uncoupling of connections on the old multiplex unit from the already modified Rf gear, and the coupling of the new multiplex unit to the Rf gear at each individual station. This was expedited through the preparation of color-coded wire harnesses. Through the use of these and previously wired selector switches, it was possible to switch from one unit to the other in about 5 minutes for testing purposes.

A maximum of 23 operations or modifications had to be made at the stations. The number of these to be made at any one station depended on whether it was a repeater station, whether it was a main station tied into many other channels, or whether it was a main station tied in with just a few stations.

A master checkoff list was drawn up to maintain a progress record of the construction and modification work done at the various stations. Since each station had different requirements to be met, a master sheet was used, with each station shown across the top of the sheet, and the modifications numbered at the left of the sheet. If a station required a specific modification, a cross mark was put in at the proper spot opposite the station number and modification number.

A dash at the spot would signify the modification didn't have to be made at that specific station. Once all crossmarks were checked off at each station, it was ready for testing. The magnitude of work involved in these preliminaries can be seen in that 383 separate operations or modifications were required in the preliminary work.

Testing . . . Individual tests were made of each station prior to the final cutover of all stations. In making the tests, the Transco communications department had to remove the "bugs" from each station prior to the final cutover. This had to be done at a time when demand continued high for microwave time. The only course was to conduct the tests at night and for about 3 months the tests continued.

The general procedure followed was to cut in equipment at Houston and then have a station up the line cut in on the new equipment. The tests would then be conducted between the home station and the outlying station until it was time for the routine pressure report of the station. It would then be cut back into the old system, the pressure report made in keeping with the regular dispatcher's schedule, and then the testing was resumed.

During the drawnout period, hundreds of checks were made back and forth. Bad connections were corrected, faulty tubes were replaced, loose joints were tightened and other faults attended to. By the time the cutover date arrived, practically all of the equipment had been tested and checked out as satisfactory.

Cutover . . . In the actual transition from the old to the new multiplex system the time element was far more acute. The cutover to the new equipment had to be made on all channels, and communications had to remain operative for normal pipeline requirements. Transco communications people, with the assistance of four additional men sent by G. E., manned all but four of the stations for the final cutover.

A weekend was picked when communication demands would be at a minimum, and "Operation Cutover" began. Only 14 of the available 25 channels were put into service by Transco in this phase of the expansion. It was felt that this would take care of current requirements. The additional channels can be added simply and at a relatively low cost by just adding a modulator and demodulator unit at those particular stations where new channel outlets will be desired in the future.

When the new multiplex equipment was installed during the preliminary work, it was mounted close to the existing cabinets. When the time for the cutover arrived, this equipment was connected, the old multiplex units removed, and the new equipment slid into position.

With the exception of about 5 minutes for making various connections, there was no lapse of microwave service to any of the stations. As might be expected, however, some difficulties, such as short outages, developed during the cutover, and these had to be corrected when discovered.

Station testing . . . Considerable time during the cutover period was spent

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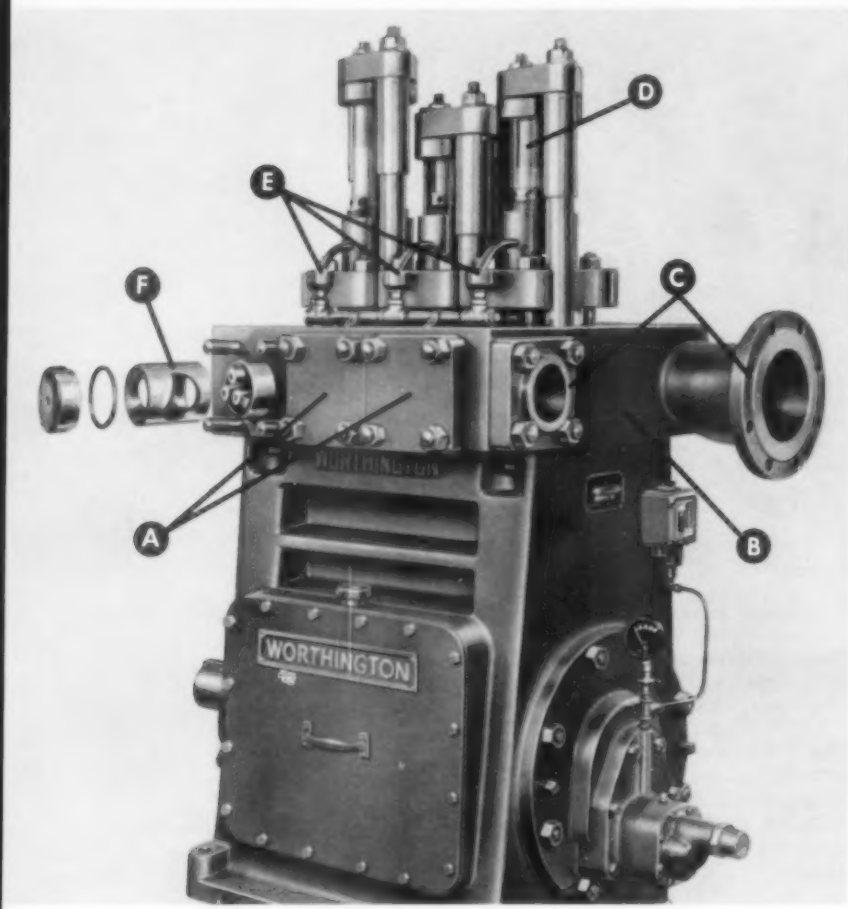
Your answers will be compared with the results of a survey already completed among men who use waterflood pumps and know them intimately. To the ten entries closest to the majority opinion go the ten big prizes.



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WORTHINGTON

P.7.1.

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	1	2	3	4	5	6	7	8	9	10
Feature A										
Feature B										
Feature C										
Feature D										
Feature E										
Feature F										

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in testing all of the stations on the network and checking them out with all of their respective dropouts. It was this testing, plus the trouble-shooting, which kept the crews on duty on round-the-clock service over the weekend.

During the first hours following the cutover, operations did become erratic, as might be expected. Some equipment which checked out perfectly during the preliminary tests picked this time to fail. However, by Monday, the network was operating satisfactorily, with the exception of two stations where faulty equipment required additional work.

Tests had to be conducted both from the home office in Houston to each station on each channel, and also between each station and other stations sharing the same channel. On channel 2, for instance, dropouts are made at all stations on the line, and Houston had to check out with the 20 stations, and these had to be checked out with the 20 stations, and these had to be checked out against each other. Channel 15 was much simpler, for tests only involved seven stations. Channel 22 was another party line which required considerable testing. The program was setup to test out each station successively up the line.

If trouble developed, the station was then bypassed and the test rerun later during the weekend. The four unmanned stations were fitted into the program. As other stations checked out all clear, communications men were shifted to these four stations so that it was possible to complete the entire cutover and testing during the weekend period.

Existing multiplex equipment was removed and salvaged for replacement in the south sector of the network and also for those components which are common to the new and old systems.

Acknowledgements

The cooperation of the management of Transcontinental Gas Pipe Line Corp. in the release of this information and the cooperation of H. A. Rhodes in its preparation is gratefully acknowledged.

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1. Evans, W. E., and Lowe, R. F., "Quadriphase—A New Approach to Time Division Multiplexing," American Institute of Electrical Engineers Transactions, June 27, 1955.

2. McConoughey, Sam, "The Quadriphase Microwave System," Radio-Electronic Engineering Edition, Radio & Television News, April 1955.

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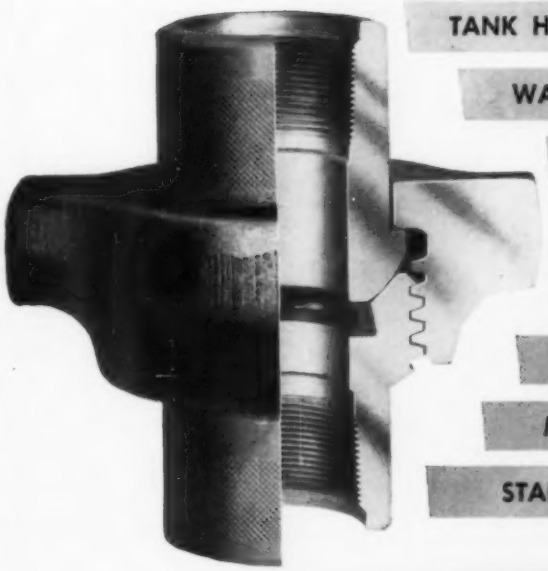

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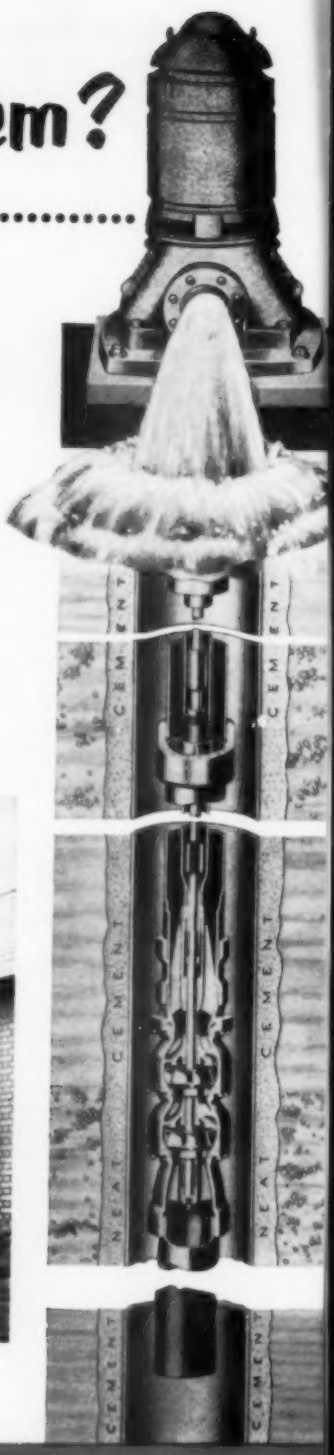

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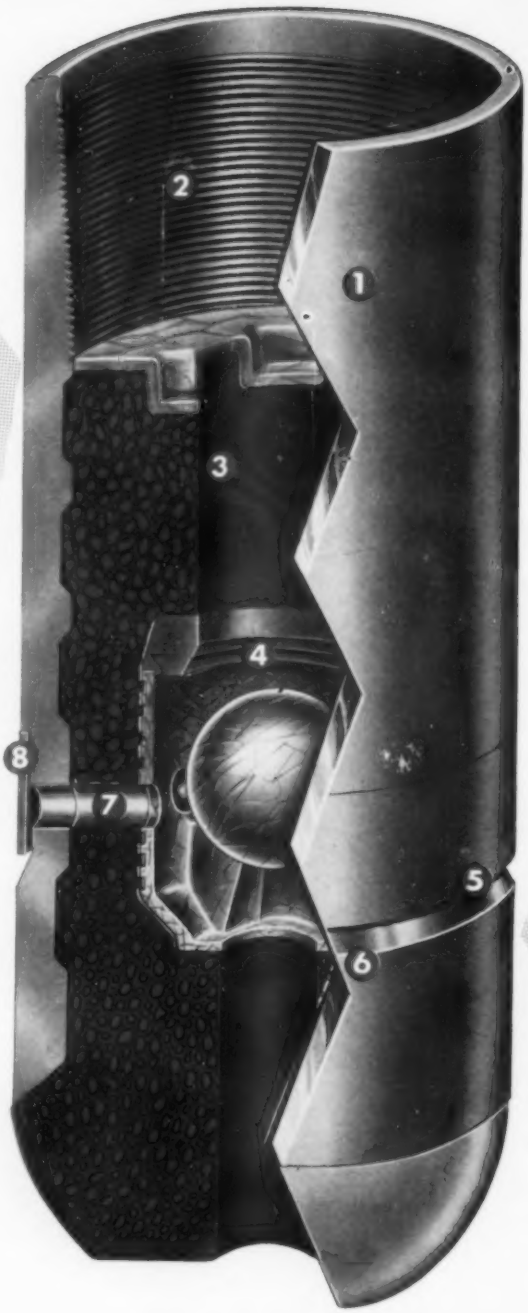
2. Furnished with any thread desired.
3. High strength, scientifically cured red granite concrete.
4. Superior all-Bakelite back pressure valve. The strong, efficient back pressure valve assembly is composed of a precision-ground Fabric Base Bakelite Ball which seals against a firmly reinforced Hycar seat. Valve seals immediately against high or low pressures and is stronger than the collapse strength of the casing.
5. Geyser action discharges slurry around the entire periphery of the shoe to assure an even distribution of cement and to minimize channeling.
6. Geyser action up or down.
7. Eight large discharge ports provide unrestricted flow into the peripheral discharge area.
8. Single baffle plate provides powerful 360 degree jetting action.



The Larkin-Field-Proved Shoe design has won in field after field the reputation of doing **all** that a cementing shoe can do to contribute to a successful cementing job. Specify Larkin Geyser Shoes and Collars on your next cementing job. They are sold ". . . through your Supply Store."

LARKIN PACKER COMPANY, INC.

WAXAHACHIE, TEXAS

LARKIN

...Through Your Supply Store

LARKIN LEADERSHIP HAS BEEN EARNED BY YEARS OF DEPENDABLE PERFORMANCE

New Equipment

priate connections for applying pressure.

Its working pressure is 3,000 psi. at 400° F. A relief valve set at 3,000 psi. regulates pressure during normal schedule tests. As a final absolute safety device, a blowout disk is incorporated in the piping system. It exhausts through the water outlet if pressures exceed the 5,000-psi indicating-pressure-gage limit.

Heat is applied by external heaters totaling 4,200 watts grouped on two circuits to provide high heat for fast temperature rise and low heat to maintain final curing temperature. Temperature control is by means of an autotransformer and a Brown Pyr-O-Vane.

A mold hoist facilitates the insertion and removal of cement specimens from the pressure chamber. Valves, switches, pilot lights, etc., are provided as required by the operation. The entire instrument is mounted in a stainless-steel cabinet with these over-all dimensions: 70 in. high, 33 in. wide, and 29 in. deep.

Utilities required are compressed air at 100 psi. and electric current of 110-volt, single-phase, 60-cycle, 40-amp. capacity. Clean water of 30 psi. or more is used as the hydraulic medium. **Write or call: Refinery Supply Co., 621 East Fourth Street, Tulsa 3, Okla., for details on Model 7-350 pressure-curing chamber for cement.**

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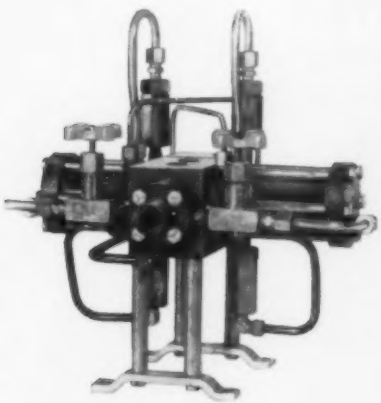

Glycol Pump Is Powered by Wet Glycol

High-pressure liquid-level controls on the absorber of glycol type of gas dehydrators may be eliminated through the use of this new Kimray double-action glycol pump, according to company officials. Wet glycol from the absorber plus a small amount of gas (about 3 std. cu. ft. per gal. of glycol at 1,500 psi.) powers the pump.

Available with a working pressure of 1,500 psi. and capacities from 40 to 450 gal. per hour, the pump has only two moving assemblies and forms a completely closed system. It uses no springs or toggles and no packing is exposed for leakage. Pumping rate is controlled by self-cleaning valves.

The pump provides protection from fire as distillate is not dumped to the reboiler in large batches. **Write or call: Kimray, Inc., 52 N. W. Forty-Second Street, Oklahoma City, for details on glycol pump.**

Gas Chromatograph Permits Fast Analysis

Here is an instrument providing quick and accurate analysis of gases and liquids with boiling points up to 350° C., the maker states. Called the GC-2 high-temperature gas chromatograph, it employs the fundamental principal of gas chromatography, using a tubular column packed with a material that separates components by passing them through the column at different rates. Carrier gases used to move the sample through the column include

Give Your DRILL COLLARS a GOOD BREAK!

WITHSTANDS HIGHEST TORQUES WITHOUT SEIZURE IN THREADED CONNECTIONS

EXCEPTIONAL RESULTS IN BREAKING IN NEW TOOL JOINTS

Manufactured under U.S. Pat. No. 2,543,741

Contains Copper Flake, Metallic Lead & Graphite

World's Toughest and Finest

DRILL COLLAR & TOOL JOINT COMPOUND

KOPR-KOTE gives the best anti-seize and washout protection available. Only real compound improvement in recent years . . . KOPR-KOTE has proven superior in the deepest, hottest holes under all extreme high loads, torques and pressures. KOPR-KOTE forms a tenacious armored coating against metal-to-metal contact. Cuts thread wear . . . lengthens tool joint life. Assures efficient, full make-up with low torque breakout. Prevents galling, tearing and high temperature freeze. KOPR-KOTE will not squeeze out, nor harden or compact in thread roots. Will not separate in container. KOPR-KOTE is unexcelled as a leakproof sealing compound for casing and tubing connections. See Composite Catalog or write for literature.

JET-LUBE

In the U.S.A. & Canada SOLD EXCLUSIVELY THRU SUPPLY STORES

JET-LUBE, INC.
MAIN OFFICE:
3093 N. California St., Burbank, Calif.
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Edmonton, Alberta
Jet-Lube (Australia) Pty, Ltd.
Perth, W. Australia
Jet-Lube Ltd. (England)
Wolverhampton & London

24-Hour Tour

The oil industry keeps hours . . . 24 in every day. And it drills and completes wells at all hours and in all places — next door to cities, but also in the marshes, in the mountains, under the ocean. Efficient field service is difficult, but an absolute necessity.

America burns a lot of oil at midnight.

Maybe it's in the form of kerosene . . . in a lamp to light the shack of a trapper in the wilderness.

Or, perhaps it's the kind of oil that provides fuel for generators . . . generators that provide another kind of light and tremendous power for industries, power for the home.

Maybe the oil propels a ship, lights a buoy, keeps emergency vehicles operating.

People drill at midnight, too. They must, if the power needs of America are to be met.

They drill at noon, too; yes, around the clock.

They drill deep and shallow and tap big oil and gas pools and little pools.

All of this drilling—at all hours, in all weather, under all kinds of conditions—requires not just equipment, but specialized equipment. And equally important, specialized service.

That's why the Oil Center Tool Company has come to play such a big and vital part in the oil patches wherever they may be.

O-C-T equipment is precision-designed and engineered, precision-made and precision-installed.

Field service has distinguished the company as much as the equipment itself.

O-C-T field engineers and service men, as close as the telephone, always are available for expert installation at any location, at any time, in any weather.

They get the job at hand done . . . quickly and efficiently.

But they're always looking ahead, these O-C-T men.

Completion problems of tomorrow are their problems.

That's why O-C-T field men keep such close contact with oil company engineers and drilling and production supervisors—to develop better equipment.

A problem encountered in the birth of a new oil or gas well today may mean the birth of a new O-C-T product tomorrow.

At midnight, noon or 4 A.M. in the coyote country of West Texas, the altitude of the Rockies, the marshes of Louisiana, the spray of the Gulf of Mexico, O-C-T men are available.

Available with the best techniques and the best equipment.

O·C·T

OIL CENTER TOOL CO.

Export Representatives: South America — East West Oiltools, C. A., Del Lago Hotel, Maracaibo, Venezuela. Address Export Inquiries for All Other Countries to P. O. Box 3091, Houston, Texas.

It's 9 p. m. The hanger is in place and the O-C-T Service Engineer at left is aided by a member of the drilling crew as the first unit of the well control system is put into place. At midnight this O-C-T man was on another well, in another field. He is always available, like all O-C-T service and sales personnel—regardless of the time or type of job.

New Equipment

hydrogen, helium, carbon dioxide, nitrogen, and argon.

Applicable for research, quality control, and other analytical problems, the GC-2 is considered especially useful in the fields of petroleum refining, natural gas, L.P.G., and petrochemicals.

Regulated flow control increases over-all stability and eliminates pressure surges which could give false readings on chromatograms. The instrument is line operated on 115-volt a.c. power.

It can be connected to a 1 mv. high-sensitivity potentiometric recorder for reproducing values of 0.1 per cent full scale. **Write or call: Scientific Instruments Div., Beckman Instruments, Inc., Fullerton, Calif., for Bulletin 711.**

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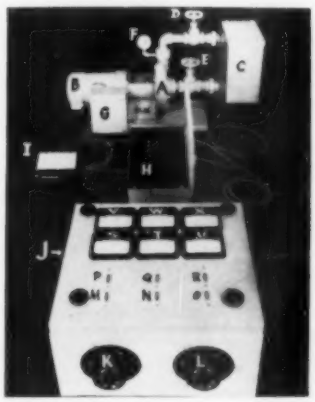

Protecting Relay Prevents Failure from Overload

Here is a precision device designed to protect three-phase induction motors against failure due to shaft overload, voltage unbalance, and/or single phasing.

Designated as ESCO Type TS motor-protecting relay, the instrument employs the basic principles of symmetrical components to effect a dropout of any motor that approaches the stage of dangerous overheating from either one or any combination of the three faults.

It is manufactured to extremely close tolerances, the maker says, to meet the nameplate data of the motor for which it is intended. The device is available in any of the standard N.E.M.A. type of enclosures. Each unit is custom built. **Write or call: Electrical Service Co., Ardis Heights, Greenville, Tex., for details on Type TS motor-protecting relay.**

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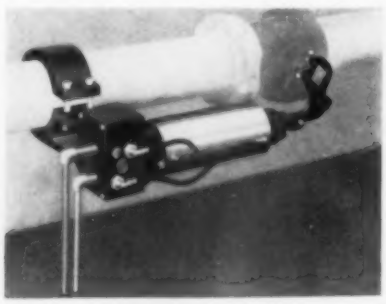

Plug-Valve Actuator Permits Automatic Operation

Automation for plug valves may be achieved with this new actuator designed for automatic operation, either

PENN SAFETY CONTROL guards engines 'round the clock!

You never have to worry about damage resulting from overheating or lubrication failure when your engine is protected by a Penn Safety Control. It faithfully guards your engine day and night — warns you immediately when cooling water overheats or oil pressure drops too low.

If this occurs — and it can happen to the finest engine — the Penn Safety Control automatically sounds an alarm, flashes a warning light, or stops engine operation...whichever you choose. Then the cause can be investigated and the fault corrected — before serious damage costs you time and money.

ASK YOUR JOBBER about this dependable, low cost, automatic protection for your new or old engine.

PENN CONTROLS, INC. Goshen, Indiana

EXPORT DIVISION: 27 E. 38th ST., NEW YORK, N.Y.

AUTOMATIC CONTROLS FOR HEATING, REFRIGERATION, AIR CONDITIONING, GAS APPLIANCES, PUMPS, AIR COMPRESSORS, ENGINES

New Equipment

in existing installations or new projects, the maker reports.

Featuring positive and complete closing, the actuator offers applications in petrochemical plants, refineries, and tank farms. Ruggedly built, the actuator is a packaged assembly, delivered ready to attach to the pipe and plug-valve stem in a matter of minutes without special tools.

Now manufactured in valve sizes from 1 to 8 in., it is designed to fit all popular makes of plug valves. **Write or call: Pantex Mfg. Corp., P. O. Box 660, Pawtucket, R. I., for details on plug-valve actuators.**

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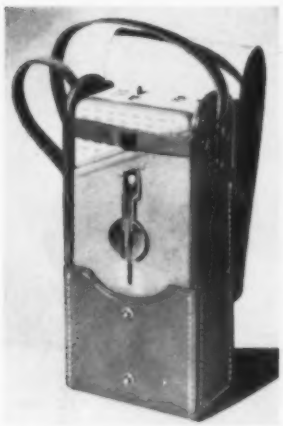


Pocket Tape Recorder Records Voices from 30 Ft.

Fitting into a top-grain-leather carrying case with shoulder strap, this tape recorder is small and light enough to put in the pocket. Powered by self-contained batteries, the machine allows 1-hour recordings to be made.

A recording-time indicator tells how much recording time has been used and how much is still available. Too, the indicator makes it possible to locate any portion of a recording for playback.

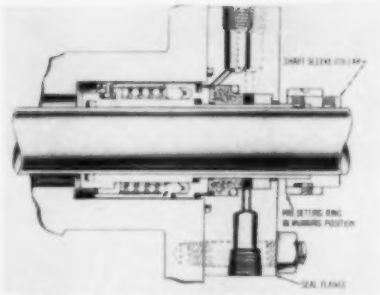
The batteries, of the hearing aid type, are instantly removable and snap fasten into the machine. A battery-life indicator, a small light, goes off when the battery life has only 2 hours remaining.

The Travel-Corder is cartridge loaded. The cartridge, the size of a pack of cigarettes, is reusable. It inserts into the recorder. No threading is required. **Write or call: Michigan Electronics, Inc., 854 North Rockwell Street, Chicago 22, Ill., for details on Travel-Corder.**

Mechanical Seal Uses Presetting Ring

Mechanical-seal installation without measurement is permitted by a built-in presetting ring feature incorporated in this new BJ mechanical seal.

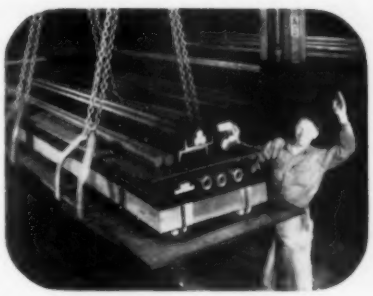
The new development provides a seal assembled as a cartridge unit ready for installation, the maker reports. No field fitting is required. The presetting ring feature is expected to speed installation time. It greatly reduces downtime on periodic pump inspections, particularly with two-bearing pumps, such as horizontal pipeline and boiler-feed pumps and vertical pumps which require impeller adjustment. **Write or call: Byron Jackson Pumps, Inc., P. O. Box 2017A, Terminal Annex, Los Angeles 54, Calif., for details on mechanical seal with presetting ring.**



Three ways Ryerson can serve you

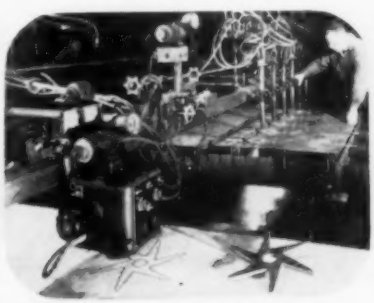
You know that Ryerson carries the world's largest steel stocks. And that every piece bears the Ryerson certified seal of high quality.

But did you know that there are other important ways Ryerson can serve you? Two of them are illustrated here: plastics and flame-cutting. Complimenting these services is our staff of specialists (men who know your industry's requirements) who work with you. So for *complete* service —call Ryerson.



STEEL FROM STOCK—Carbon steels, alloys, stainless—bars, structurals, plates, sheet and strip, tubing—you can get quick shipment of one piece or truckloads from the world's largest steel stocks, at Ryerson. Get the steel with the certified seal—of quality.

PLASTICS FROM STOCK—The convenience and dependability of Ryerson service is also available to buyers of industrial plastics—PVC pipe, valves and fittings, sheets and rods, rigid Kralastic pipe, flexible polyethylene pipe and tubing, etc.



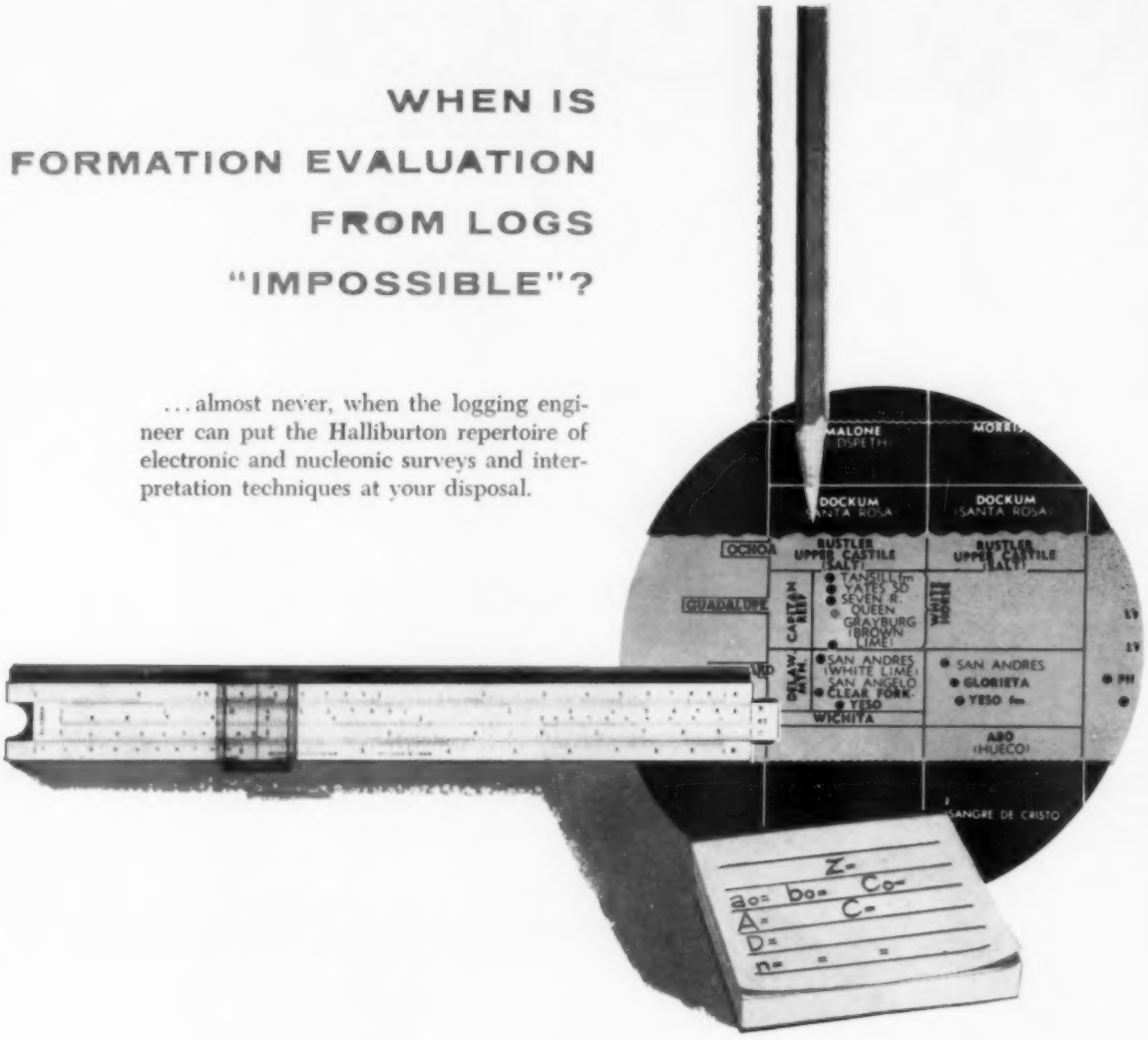
FLAME CUT STEEL SHAPES—Your nearby Ryerson plant can quickly flame cut almost any shape from carbon, alloy or stainless steel—producing a single piece or thousands accurate to size and ready for your application. We take the work load—you save money.

RYERSON STEEL

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • WALLINGFORD, CONN. PHILADELPHIA • CHARLOTTE • CINCINNATI • CLEVELAND • DETROIT • PITTSBURGH • BUFFALO CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO • SPOKANE • SEATTLE

WHEN IS FORMATION EVALUATION FROM LOGS "IMPOSSIBLE"?

... almost never, when the logging engineer can put the Halliburton repertoire of electronic and nucleonic surveys and interpretation techniques at your disposal.



That assurance is justified by case histories like the one on the opposite page. It's the latest of a series published in recent months, demonstrating how Halliburton Radiation-Guard Logging and interpretive methods have been successful in evaluating reservoirs that would have been extremely difficult if not impossible for other types of survey to cope with.

For a frank discussion—at either professional or layman's level—of possible advantageous applications of this or other advanced Halliburton logging techniques to the evaluation of your "problem wells", speak to any Halliburton EWS field engineer. You'll find him an easy man to talk over your problems with.

HALLIBURTON

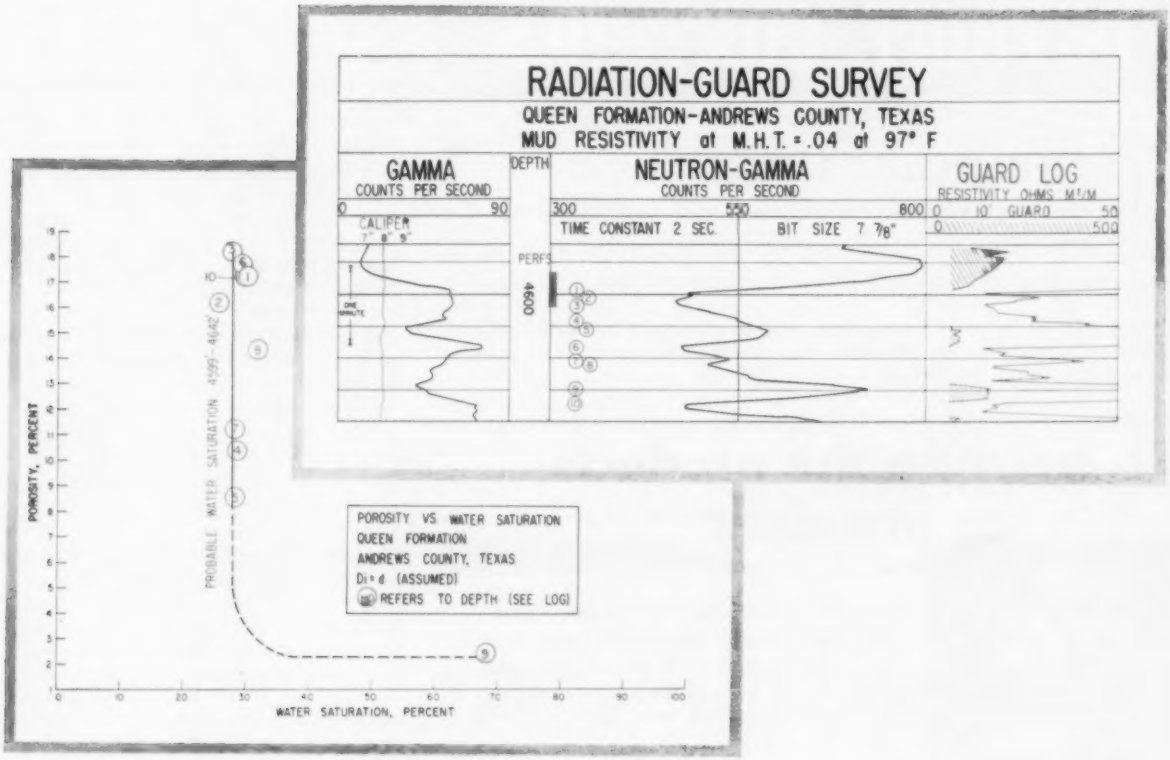
OIL WELL CEMENTING COMPANY

DUNCAN, OKLAHOMA

THIS HALLIBURTON RADIATION-GUARD LOG

LED TO 116 BOPD

near hard-to-spot transition in Andrews County reservoir



The log curves and calculated water saturation curve shown here were obtained from a customer's well in the Queen formation of West Texas-New Mexico, which is normally composed of sand, dolomite, anhydrite and salt. Porosities and permeabilities in this formation tend to be low. When they are as low as they are at this location, the transitional zone above an oil-water contact is long and hard to recognize.

The Halliburton log and analysis strongly indicated that all of the section was in the region of irreducible water saturations well above the transitional zone. Therefore no water production was anticipated. Twenty-six feet of the section were evaluated as porous enough to produce, with average porosity calculated at 14 percent and average water saturation at 30 percent.

The well was completed by perforations in the interval shown. After a 5000-gallon Halliburton fracturing job, the well produced 116 barrels of oil per day.

ELECTRICAL WELL SERVICES

"ELECTRONIC EYES FOR OILMEN"

D.T. Williams and DETROIT CONTROLS

the names are good

Reputation is a matter of record. And the record of D. T. Williams for dependability and performance has been firmly established over the years.

Now, as a part of Detroit Controls, the high quality is being maintained, so that you may continue to place your confidence in this product, assured of ready supply and good service.

because the products are right

No. 856 "Vulcodisc" Lift Check Valve

Vulcanized asbestos disc. For 200 lbs. working steam pressure at 500° F. or 400 lbs. working non-shock gas and liquid pressure at 150° F. Installed in horizontal position. Screw cap and screw ends.

No. 1086 Swing Check Valve

Vulcanized asbestos disc. For 200 lbs. working steam pressure at 500° F. or 400 lbs. working non-shock gas and liquid pressure at 150° F. Installed in horizontal or vertical position. Screw cap and screw ends.

No. 912 "Vulcodisc" Globe Valve

May be used for steam or hot water with pressures to 200 lbs., temperatures to 500° F.; or water, gas and air to 400 lbs. at 150° F.; for oil to 200 lbs. pressure at 250° F.

No. 833 Horizontal Check Valve

Renewable composition, air disc, integral seat, screw ends, spring loaded disc. 300 lbs. working non-shock gas and liquid pressure at 150° F.

These valves meet all government, marine and industrial specifications.

Bridgeport 1, Connecticut

DETROIT CONTROLS

Division of American-Standard

SHOWCASE . . .

New Literature

Maintenance Paints. This new six-page foldout describes a line of coatings for use where extreme humidity and water-immersion conditions prevail. It gives applications and recommended storage and handling precautions. **Write or call: Kansas Paint & Color Co., 132-134 North Mosley Avenue, Wichita, Kans., for foldout on maintenance paints.**

•

Two-Way Radio Interchangeability is the subject of new eight-page Bulletin ECR-458. It describes the building-block design of a two-way radio, explaining how the components may be interchanged between station and mobile combinations to achieve flexibility. The bulletin also covers the adaptability of the building-block design in adding optional equipment, such as selective-signaling, selective-calling, and simultaneous monitoring. **Write General Electric Co., Electronics Park, Syracuse, N. Y., for Bulletin ECR-458.**

•

Diamond Selection in Oil-Well Drilling is explained and discussed in new four-page brochure Series 1001. The brochure discusses proper selection of stone sizes and types for various formations encountered in oil-well drilling and coring. **Write or call: American Coldset Corp., 87 Court Street, Paterson, N. J., for brochure on diamond selection in oil-well drilling.**

•

Pump Valves. This new eight-page bulletin describes Durabla pump valves, redesigned to incorporate a new taper-lock stud, self-locking nut, and dropon guard. Tables give pressure-temperature ratings, materials of construction, seat sizes, and other dimensions. The bulletin includes data for ordering valves with pressed taper fits, screw fits, or rough-cast seats for finishing by the customer. **Write or call: Durabla Mfg. Co., 114 Liberty Street, New York 6, N. Y., for bulletin on pump valves.**

•

Slide Chart on Machining Stainless Steels. This handy chart, measuring, 9¼ by 4¾ in., contains information on how to machine the popular grades of stainless steel. On one side it gives concise data on turning, drilling, tapping, threading, milling, and reaming operations. It tabulates speeds and feeds and gives special notes on drilling, tapping, lubrication, and welding. The other side of the chart shows

relative workability of stainless steels in a variety of operations, including blanking, deep drawing, stamping, forging, heading, roll threading, welding, etc. An inserted slide moves to show, at a glance, the machining data desired. **Write or call: Carpenter Steel Co., West Bern Street, Reading, Pa., for slide chart on machining stainless steels.**

●

Hydraulic Starting System for diesel engines which provides instant starting while eliminating the maintenance costs of batteries, cables, magnetos, and air compressors is fully described in this new four-page brochure. Cutaway drawings illustrate how the starting system works, and text explains its advantages. **Write or call: Detroit Diesel Engine Div., General Motors Corp., 13400 West Outer Drive, Detroit 28, Mich., for hydraulic-starting-system brochure.**

●

Precision Pressure Meter. The Press-I-Cell, an instrument for the precise measurement of absolute, gage, or differential fluid pressures is the subject of new Catalog 11-102. The catalog describes the instrument as measuring gases or liquids over pressure ranges from 0 to 4 to 0 to 1,000 psi., with a degree of accuracy as high as 1 part in 2,000. Readability of the scale is of the order of 1 part in 8,000. The pressure-sensing mechanism consists of capsules or spirals. When deflected by pressure, they set an armature in motion within a set of differential coils. The electrical signal produced goes to a servo motor driving a 150 to 200-in. film scale to indicate the precise pressure value. Remote transmission is possible by photo pulse, digital, resistance, or shaft outputs. Alarms are available for use with the instrument. Explosionproof and portable models can be had. **Write or call: Fischer & Porter Co., 99 Jacksonville Road, Hatboro, Pa., for Catalog 11-102.**

●

Rubber, Neoprene, and Teflon-Lined Expansion Joints, their construction, sizes, and uses, are fully explained in new Bulletin AD-137. The bulletin describes the characteristics and limitations of seven styles of expansion joints and flexible couplings: (1) spool type of expansion joints, (2) rectangular type of expansion joints, (3) U type of joints, (4) all-Teflon expansion joints, (5) all-Teflon flexible couplings, (6) full-face Teflon-lined rubber expansion joints, and (7) expansion joints for use on piping and flanges. The bulletin also describes full-face Teflon-lined rubber expansion joints and a rubber expansion joint equipped with a Teflon liner. **Write or call: Garlock Packing Co., 408 Main Street, Palmyra, N. Y., for Bulletin AD-137.**

●

Metallic Epoxy Putty. Here is a four-page illustrated bulletin describing aluminum-filled epoxy resin compounds for use in any repair or maintenance activity requiring a chemically stable, nonshrinking, and nonflammable putty with good adhesion to iron, steel, aluminum, wood, glass or ceramics. Designated Bulletin 11, it outlines many uses for the putty and describes its advantages, such as ease of mixing, convenient room-temperature curing, and machinability. Detailed illustrated descriptions tell how the oil and waterproof material should be used for successful application. The bulletin details the various curing agents available to give rapid cure, extreme hardness, or greatest adhesion. **Write or call: Smooth-On Mfg. Co., 572 Communipaw Avenue, Jersey City 4, N. J., for Bulletin 11.**

●

Brass-Tube Fittings Catalog (48 pages) lists all sizes and types of brass fittings manufactured by Weatherhead Co., including a section showing the complete line of drain and shutoff cocks. Other subjects covered are push-pull controls, complete assembly instructions on all brass fittings, data on right and wrong ways for tubing a system, tube fitting data, and tools. **Write or call: Weatherhead Co., 128 West Washington Blvd., Fort Wayne, Ind., for brass-tube fittings catalog.**

●

Millivoltmeter Recorder. Here is a new bulletin on a portable millivoltmeter recorder for use in electrolysis survey work. The four-page bulletin describes the use of the new instrument in surveys of electrolytic corrosion and deterioration of underground structures such as pipe and cables. It includes a bibliography on actual testing methods and their significance. The millivoltmeter recorder, weatherproof and completely self-contained, records on an 8-in.-diameter chart which can be furnished to rotate once in 96 hours, 3 days, or 7 days. Instruments are available with movement sensitivity of either 2,000 or 10,000 ohms per volt. Each one is equipped to measure over eight ranges which are selected by a tap switch. **Write or call: Bristol Co., Waterbury 20, Conn., for Bulletin E1117.**

Tennessee's Copper Chloride was developed to effect efficient Mercaptans removal.

Place your confidence in a basic producer of Copper Chemicals.

CUPRIC CHLORIDE DI-HYDRATE

Other products of interest— Ferric Sulfate—Copper Sulfate, Copper Oxide—Sulfur Dioxide.

For samples make request on your company letterhead.

TENNESSEE TC CORPORATION

617-627 Grant Building, Atlanta, Ga.

EQUIPMENT MEN . . . in the News

FMC, Chiksan Executives Attend Weco Sales Meeting

The first sales conference since occupying its new office and plant was held recently by Well Equipment Manufacturing Corp. Attending were (first row): John W. Gates, vice president and sales manager, Weco; G. R. Winder, vice president and general sales manager, Chiksan; H. J. Hagn, president, Chiksan; L. L. Durkin and Don Wilson, Weco; J. H. Robinson, vice president and general manager, Weco; V. T. Norton, Weco; W. A. Wolff, John Bean Division, Food Machinery & Chemical Corp.

Second row: Benjamin C. Carter, executive vice president, FMC; T. R. Shields and J. A. McCreery, Weco; Frank Wiegand, Chiksan; I. D. Abshire, Weco; F. N. Runnells, Chiksan of Canada, Ltd.; O. J. Viator, Weco; A. L. Schmitz, FMC; A. H. Watts, Weco.

Third row: C. J. Holcomb and F. A. Jordan, Weco; A. E. Plomp, Chiksan of Canada, Ltd.; M. M. Bowen, Weco; M. W. Cook, Chiksan; J. C. Wood, Weco; W. Jeffery, Chiksan of Canada; W. C. Meeks and D. J. Parmesan, Weco; H. W. Roessler, Chiksan; C. V. Marshall, J. C. McCelvey, T. R. Stunkard, C. H. Callihan, W. H. Brien, Dale Delong, J. R. Thrasher, and C. E. Gisler, all of Weco.

Union Switch & Signal Names Steel to Sales Post

John T. H. Steel has been appointed sales engineer in the general apparatus sales department of Union Switch & Signal, division of Westinghouse Air Brake Co., according to Paul K. Eckhardt, manager of general apparatus sales.

Steel was employed by Union Switch & Signal as a junior engineer in the pipeline control systems section, a position he held until his recent promotion. As sales engineer, Steel will be active in sales and application of control systems and components.

National Tube Names McKee, Williams to Sales Posts

William J. McKee, formerly general manager of sales, will become assistant vice president of sales for National Tube Division, United States Steel

W. J. McKEE

R. E. WILLIAMS

Corp. Robert E. Williams, director, distribution and availability, U. S. Steel Corp., is appointed general manager of sales, succeeding McKee, according to Henry J. Wallace, vice president of sales of National Tube Division

McKee began his business career with National Tube in 1912. After serving in various engineering and sales positions, he was made manager of sales in Tulsa and later in New York City. In 1936 he was promoted to assistant general manager of sales in the company's Pittsburgh headquarters. In 1945 McKee was made sales manager of the central sales area and general manager of sales in 1950.

Williams served in various sales and operating posts with the former Columbia Steel Co. before being promoted to assistant to the vice president, sales, in 1949. In 1955 he was named assistant vice president of sales for Columbia-Geneva Steel division and in 1956 was appointed director of distribution and availability, United States Steel Corp., Pittsburgh.

Alco Appoints Cooley to Thermal Products Post

E. N. COOLEY

Edward N. Cooley has been named vice president of Alco Products, Inc., according to Perry T. Egbert, president. Cooley will be in charge of the company's thermal products and petroleum industry equipment divisions. Headquartered at Dunkirk, N. Y., the thermal products division handles the manufacture and sale of Alco's complete line of heat exchangers, feedwater heaters, pressure vessels and steel fabrications. The petroleum industry equipment division, with offices at Houston and a manufacturing plant at Beaumont, Tex., builds and sells a full line of oil-field and petroleum production equipment for markets throughout the Southwest. Both divisions were organized in 1956 under the company's decentralization program.

Cooley joined Alco's predecessor, the American Locomotive Co. and also served with Montreal Locomotive Works, Alco's Canadian affiliate. In 1951 he was named assistant to the president. In 1953 he completed a special assignment at Dunkirk and was named special administrative assistant to the president. In 1956 he became director of administrative services as part of a company decentralization move. He remained in that position until his latest promotion.

Oilwell Announces Four Canadian Appointments

The opening of a new sales office of United States Steel Corp.'s Oil Well Supply Division at Toronto, Ont., Canada, has been announced by W. A. Weir, Canadian area manager of Oilwell. Stanley D. Strand has been appointed as area representative there.

Howard Rainbird has been named area manager, tubular sales, at Edmonton, Alta.; Joseph L. Devlin, assistant district engineer, has been transferred from Red Deer to Okotoks, Alta.; Robert J. Mitchell has been appointed district representative at Edmonton.

Strand comes to Toronto from Calgary, where he was city representative for the past year. Rainbird, who joined Oilwell in 1947, has served as field representative and city representative.

Devlin has served the division as field engineer and assistant district engineer. Mitchell, who came to Oilwell in 1951, has served as field representative and store manager.

Commandair Appointed Aero Commander Distributor

Commandair, Inc., with sales and service headquarters located in White Plains, N. Y., and sales offices in New York City, has been granted the Aero Commander franchise for eastern New York, northern New Jersey and northeastern Pennsylvania. This announcement was made by Bob White, vice president-director of sales, Aero Design & Engineering Co., Bethany, Okla.

Lewis B. Harder is president of the newly formed organization. Sydney Nesbitt, formerly with the Aero Commander factory sales organization, has been named sales manager for Commandair, Inc. Nesbitt has had 20 years' experience in business flying and aircraft sales.

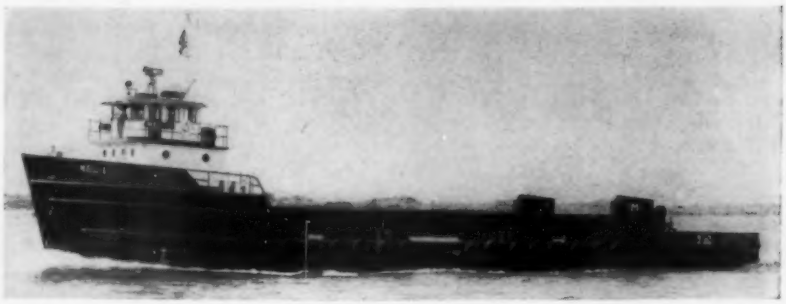
Cooper-Bessemer Opens Warehouse at Casper, Wyo.

O. C. LAWRENCE

New service and parts warehouse facilities at Casper, Wyo., have just been opened for Cooper - Bessemer Corp. engines and compressors, according to James W. Reed, Cooper-Bessemer vice president and district sales manager.

The new service and parts center, under the direction of Owen C. Lawrence, field service engineer, will stock essential service parts for Cooper-Bessemer equipment in the Wyoming, Colorado, Utah and Montana area.

The opening of the new facilities will provide closer field contact and service to engine and compressor users in the area. Cooper-Bessemer Corp. has factories at Mount Vernon, Ohio, and Grove City, Pa.



M.E.L. Rig Tender Goes Into Service

A vessel that carries both liquid and solid cargo like a barge, tows like a tug and accommodates crewmen and passengers like a pleasure boat has been put into the service of the oil industry's naval fleet by Tilman J. Falgout.

Named the M.E.L. 1, the vessel is 142 ft. long, has a beam of 34.1 ft. and a draft of 10½ ft. The proper description of the M.E.L. is rig tender.

In spite of its great tonnage of 194.5 (131 tons net), the vessel can travel 14 miles an hour loaded. The power, provided by Stewart & Stevenson Services, Inc., is two GM Detroit Diesel tandems. That means the M.E.L. has a total of four series 6-110 diesels for primary power, turning two 60 by 40 propellers at 400 r.p.m. normal. In addition, there are two 40-kw. generators, each powered by a 4-71 GM diesel engine. Total horsepower is 1,200.

The vessel, constructed by Burton Construction & Shipbuilding Co. of Port Arthur, can carry 4,000 bbl. of fuel for rigs and 450 tons of various rig supplies. It can transport enough drill pipe to drill an 18,000-ft. well.

Ryder Heads New Borger Office of Sivalls Tanks

Sivalls Tanks, Inc., has established a new district office in Borger, Tex., and appointed Elvin H. Ryder as Panhandle district manager. The new district will serve the Texas and Oklahoma Panhandles, Southwest Kansas, Southeast Colorado, and Northeast New Mexico, according to S. P. Kroeker, executive vice president.

Sivalls Tanks, Inc., was organized in 1947 with headquarters and manufacturing facilities in Odessa, Tex. It has branch offices and yards in Abilene, Tex., and Hobbs, N. M. Sales and service representatives are in San Angelo and Fort Worth as well as Odessa, Abilene and Hobbs.

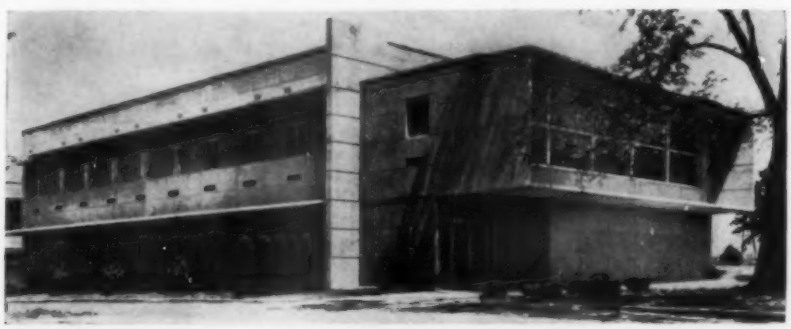
Ryder has had 17½ years' experience in the tank business in Borger. He joined Sivalls Tanks in 1953, serving as field supervisor in Odessa and later as a special salesman in the Odessa-Midland district. He also participated in expansion of the company's line to include bolted steel tanks.

J&L Assigns Robinson, Baldwin to Field Sales

J. R. Robinson, formerly Jones & Laughlin Supply Division's store manager at Worland, Wyo., has been appointed sales representative for the Farmington, N. M., area. Hubert Baldwin, formerly a storeman at J&L's Odessa, Tex., store, has been promoted to salesman at that location, according to W. L. Wolfe, vice president, sales.

Robinson joined J&L as a storeman in 1952. In 1954 he was transferred to Worland where he has served as salesman and later as store manager.

Baldwin joined J&L in 1948 as a storeman at Hobbs, N. M. He served the division as junior field salesman, salesman, and storeman at Hobbs, Shidler, Okla., and Odessa.



Open House Marks Completion of Petrolite Laboratory

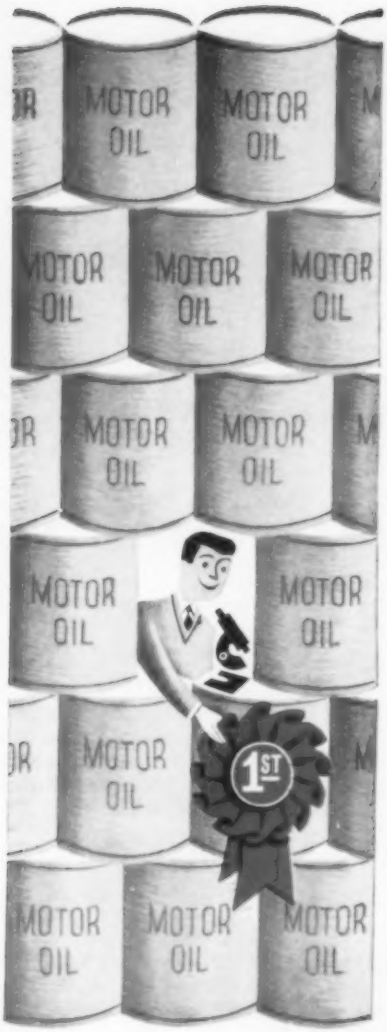
Petrolite Corp. recently observed the completion of its new research laboratory at Webster Groves, Mo., with an open house. The modern structure will house the research personnel of the Bareco, Petreco, and Tretolite divisions of the company.

The building is three stories with an enclosed floor space of 29,000 sq. ft.

Cameron Will Build Plant, Warehouse, Office Facility

Cameron Iron Works, Inc., has announced plans to construct a 30,000-sq.-ft. plant, warehouse and office building on U. S. Highway 90 between Morgan City and Franklin, La.

Approximately 35 skilled craftsmen to assemble and repair Cameron drilling control and wellhead equipment will be employed initially. Cleaning and metallizing equipment will also be used



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to rework corroded components of Cameron equipment used in offshore operations.

According to Herbert Allen, vice president and general manager of the Houston firm, this is the first of a series of moves for Cameron to decentralize repair, assembly and distribution points.

H. M. Barr, now head of Cameron's New Orleans sales office, will be in charge of the new operation.

Otis Firm to Be Known as Otis Engineering Corp.

After 20 years Otis Pressure Control is changing its corporate name. The firm is to be known as Otis Engineering Corp.

H. C. Otis originally founded the firm 30 years ago as The Southern States Co. He resigned his job as a production superintendent for Arkansas Natural Gas Co. in Shreveport to become an independent contractor for the Otis method of running and pulling tubing under pressure.

The firm soon branched out into West Texas, California, Oklahoma, and into New York. More than 500 wells were tubed by The Southern States Co. during the first 2 years of its operation. In 1935 the organization was reincorporated under the name of Otis Pressure Control, Inc.

Sims, Thorne Head CBMPE, G. P. Claridge Retires

G. V. Sims has become director of the Council of British Manufacturers of Petroleum Equipment, filling the position relinquished by Capt. G. P. Claridge, R. N. (Ret.).

E. F. E. Howard, Hayward Tyler & Co., Ltd., past chairman of the council, will act temporarily as chairman until G. H. Thorne, Dawnays, Ltd., vice chairman and chairman-designate, can take over.

G. C. Carr has been appointed to the council staff as technical adviser. T. L. Bonstow remains with the council as consultant.

Gronauer Joins Ever-Tite

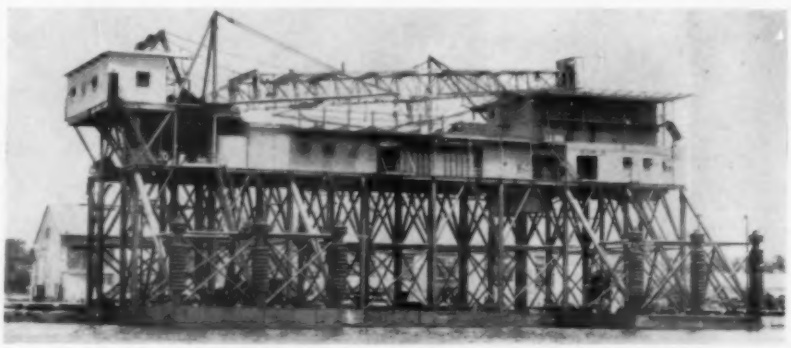
Roy W. Gronauer has joined Ever-Tite Coupling Co., Inc., as midwestern manager and sales engineer with headquarters in Cincinnati. Ever-Tite, in announcing the appointment, states that Gronauer's engineering background and wide contacts in the petroleum and chemical industries will help maintain and extend their activities in these fields.

Seadrill 3 Operates in Gulf Waters

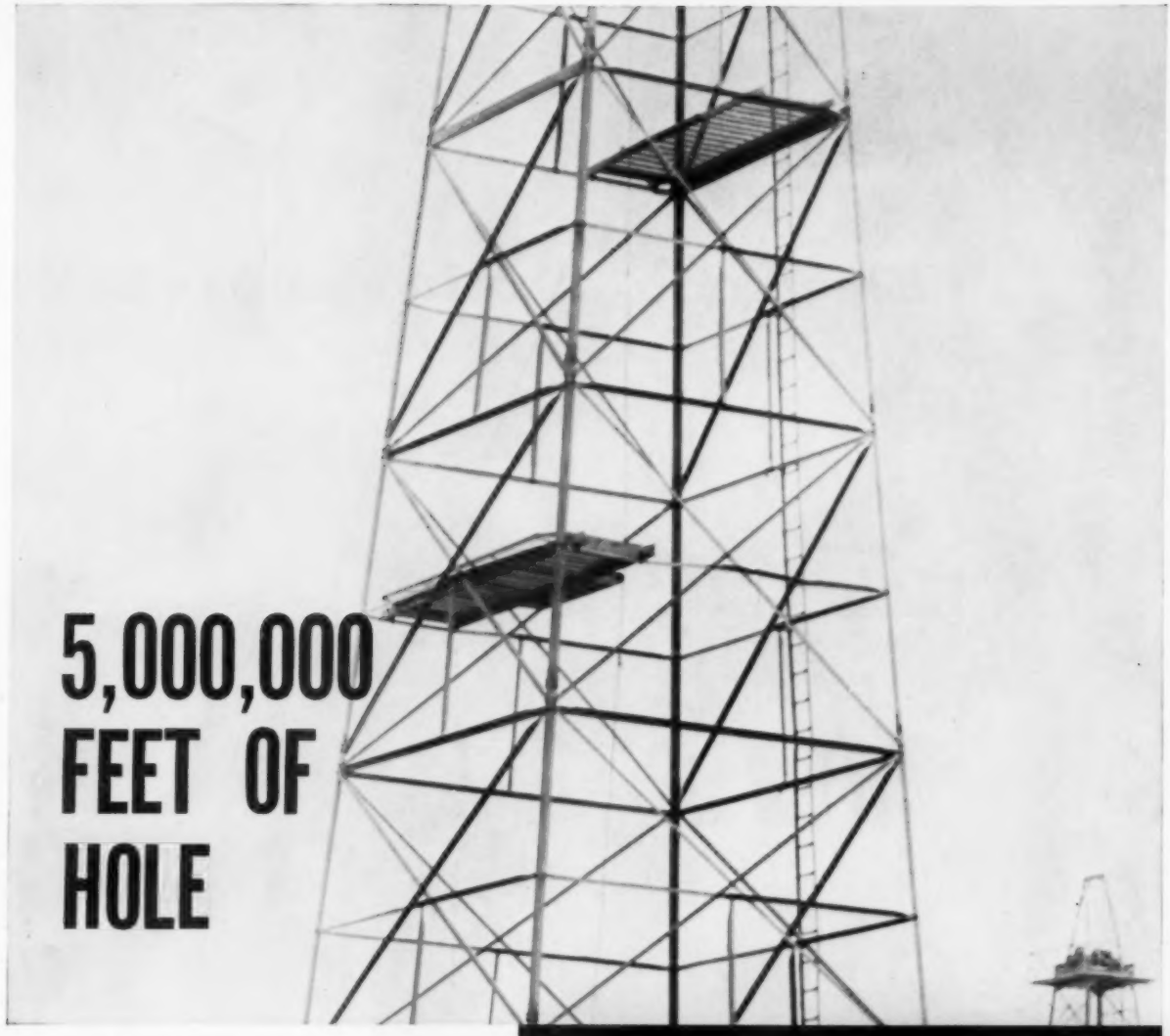
A new offshore drilling barge is the 192-ft. offshore submersible barge, Seadrill 3, which was recently completed by American Marine Corp. of New Orleans for Sea Drilling Corp. Meanwhile a second barge, the Seadrill 2, is already under construction at American Marine yards.

Major equipment on Seadrill 3 are: main power plant—three GM 12-567 diesels of 900 hp. each; three Allis-Chalmers generators, 1,200 kw.; two Elliott motors drive both Gardner-Denver GXR mud pumps. The draw works is an Emsco EDA driven by two additional Elliott motors. The mud mixing pump, a Bethlehem GOC-225, is driven by a GM 110 engine. The rotary is an Emsco PH 27½, and the derrick is the Lee C. Moore 142-ft. jack-knife type.

Additional equipment includes a Halliburton Twin T-10 skid cementing unit; a Gardner-Denver ADO air compressor; two Quincy D-325 air compressors which supply air for starting engines



The new Seadrill 3 drilling barge.



5,000,000 FEET OF HOLE

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Harold Vance, Vice President & Manager
Oil & Gas Department

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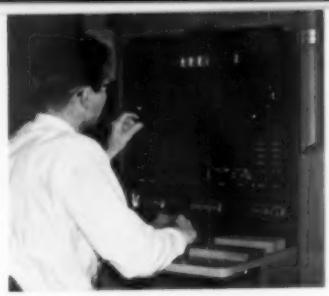
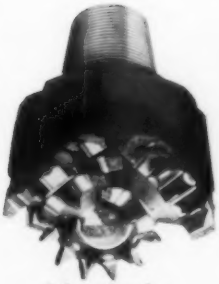
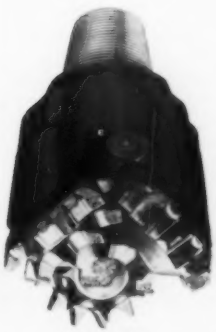


Electronic Brain helps REED

make better rock bits!



3-Cone Regular



3-Cone Jet

Modern methods make the modern Reed Y Bit

REED'S modern IBM Automatic Computer can reduce complicated data on rock bits in a matter of 90 seconds that would require an engineer many days to compute by ordinary calculating methods. Predetermined data on punched cards are fed into the intricate reading, memory, and selector units to be processed at the rate of approximately 138,000 logical decisions or "electronic thoughts" per minute.

Here are just a few of the problems encountered in rock bit manufacturing which may be resolved with far greater speed and accuracy by electronic data reduction. More efficient production and inventory control can be maintained to insure adequate sizes and types of bits when and where they are needed. In design and dimensional research, many engineering possibilities may be explored and evaluated before translating them into working prototypes. Equally important are certain problems in heat treatment which may be resolved by mathematical analysis in the IBM system far more rapidly than by destructive physical analysis of the metals.

This is REED progress—continuous improvement of product through modern methods—to provide more efficient, faster drilling rock bits.

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to 1001* process heating and cooling problems

* No one has made a recent check to determine just how many process heating and cooling assignments are taken on by standard Ross Exchangers. There may be more than a 1001, or even a few less. But this much *is* known . . .

Standard Ross Exchangers are engineered and constructed to cope with the *unusual* as well as the routine jobs in chemical processing. There are so many types and sizes, so many kinds of materials, so many alternate features available . . . it's hard to name a condition they don't meet.

Think of all the delays and costs that are spared in this way! With several designs pre-engineered and fully standardized in a large range of graduated sizes, units are readily assembled from mass produced parts and sub-assemblies in relatively no time at all . . . for each application. What could be simpler?

And when standard units cannot fill the bill *precisely for all conditions,* slight modifications often do the trick. Many a process problem has been successfully solved by Ross this way, too.

But why concern yourself with the problem at all? That's a job for Ross engineers. They're doing it for others, and can do it for you. Let Ross determine whether *your* needs call for standard, modified standard, or specially engineered units. Yes, let Ross do it, because Ross designs and builds all three!

Write Ross Heat Exchanger Division of American-Standard, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Toronto 5, Ont.

ROSS HEAT EXCHANGER

Division of AMERICAN-Standard

and air tools, two 40 kva single-phase motor generator sets which convert d.c. to a.c. current for air conditioning; one Rumba shale shaker, 4860-DU; two 15-hp. Lightning Mixers (mud); one Schlumberger skid unit; and one Gardner-Denver vertical centrifugal pump for dewatering, driven by 30-hp., 1,750-r.p.m., 230-volt d.c. electric motor for raising barge.

Baroid Promotes in Area And District Offices

J. H. V. Matthews, manager of Drilling Mud Products, Ltd., has become assistant area manager, Baroid

MATTHEWS

R. E. NICHOLS

of Canada, Ltd. He replaces Ray R. Morris who has been appointed administrative assistant, drilling mud department, Houston general office of

D. BANKSTON

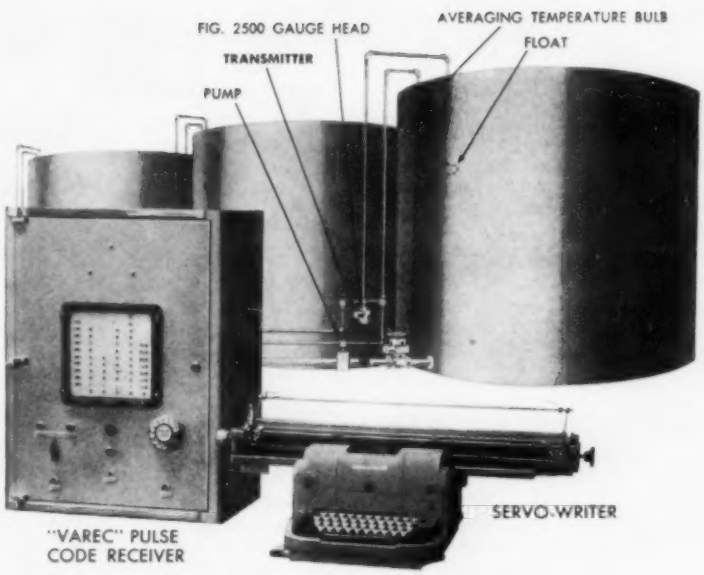
J. C. LUCK, JR.

Baroid Division, National Lead Co. R. E. Nichols is the newly appointed area engineer with headquarters in Calgary, Alta., Canada.

R. T. SUTTON

J. P. BYRNE

In the Louisiana Gulf Coast area, Fred M. Hill, Jr., former district superintendent, is the new administrative assistant, drilling mud department, New Orleans office. He was replaced as district superintendent of Southeast Louisiana by Damon Bankston, formerly sales representative in New Orleans. John C. Luck, Jr., area



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"Varec" PULSE CODE Telemetering can give you an accurate transmission system over unlimited distance for remote gauging of liquid level, temperature reading, and remote control of valves and pumps. A printed record can be provided by an electric typewriter.

Here's why . . .

1. "Varec" PULSE CODE is a true digital system. It avoids the variations of reading caused by interpolation of analog systems.

2. "Varec" PULSE CODE and the pulse count systems are the only true digital systems. In the PULSE CODE system, pulses are arranged to code groups of numbers. Each element of the code or each pulse has two possible conditions, or short and long (also called dot and dash).

The pulse count system relies on transmitting, receiving and counting a number of pulses to represent intelligence. For example, to telemeter the number 10, ten pulses are transmitted and then "counted" by the receiver. The pulse count may send 10 pulses for 10, but due to variations in the power supply, receive and indicate only nine. Whereas, if "Varec" PULSE CODE lost a pulse in transmission for any reason, the signal would make no sense to the receiver. So it refuses to provide any indication, which is better than indicating an error. Same action would occur if an extra pulse were received.

"Varec" PULSE CODE provides immunity from errors caused by changes in signal during transmission.

3. "Varec" PULSE CODE transmits a message in one-fifth of the time required by a pulse count system.

4. To prevent errors of as much as one foot during a gauging cycle, pulse count transmitter must be locked up during gauging cycle to prevent a change in reading, thus the possibility of permanently locking the transmitter is present. No such gadgets are needed by "Varec" PULSE CODE because of the unique characteristics of the code. A signal can be transmitted while the transmitter is changing without errors being produced.

5. "Varec" PULSE CODE Telemetering System is based on good operational theory

If you are planning a remote gauging and control system, you'll want the whole story. Send for "A Comparison of Current Telemetering Systems". It's free!

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Rugged service and dependable accuracy are carefully built into this fine tape. Narrow, sturdy line, with genuine Chrome Clad finish, is rust and corrosion resistant. Rollers in frame, oversize drum, and extra long handle provide extra leverage and quick, easy rewinding. Block hook with ribbed face quickly positions tape at zero for accurate measure. These are but a few of the Lufkin features that assure maximum on-the-job service.
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BETTER MEASURE WITH LUFKIN
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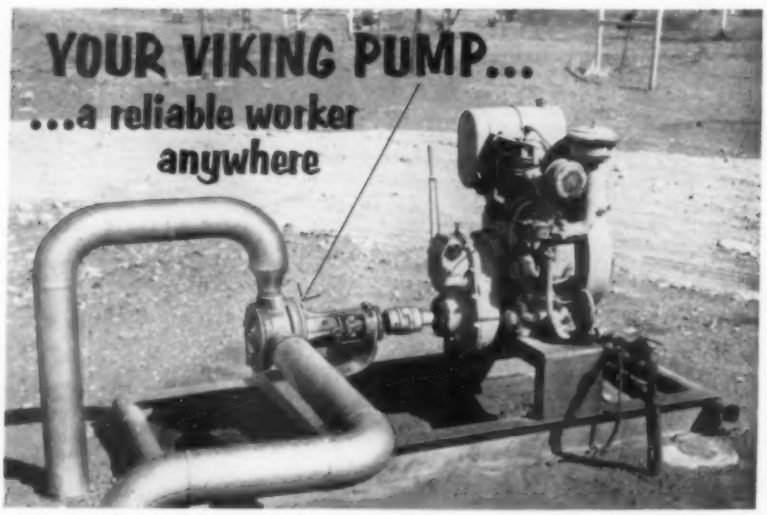

The Viking heavy-duty pump is a true friend when you need POSITIVE, smooth delivery of crude in field gathering systems.
So easy to mount and connect with its integral thrust bearing and revolvable casing. Like the installation shown here in a West Texas field, it can be located wherever it's needed.
Direct connected to gas engine with integral clutch and all mounted on skid base for quick and handy transfer. It's a willing, positive worker wherever it's used.

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VIKING PUMP COMPANY

Cedar Falls, Iowa, U.S.A. In Canada, it's "ROTO-KING" pumps
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engineer of Baroid of Canada, has been transferred to New Orleans as sales representative. R. T. Sutton, district superintendent in the Pacific Coast area, is now district superintendent of North Louisiana and Arkansas.

Ted H. Hudson, service engineer in the Rocky Mountain area, is the newly appointed store manager at Worland, Wyo., replacing R. E. Nichols. In the Pacific Coast area, Joseph P. Byrne, sales representative, has taken over duties as district superintendent in northern California and will operate out of Bakersfield.

Beaird Names Finuf as General Manager of Sales

M. A. FINUF

Melvin A. Finuf, formerly assistant general manager of sales, has been promoted to general manager of sales of The J. B. Beaird Co., Inc., Shreveport, La., according to John L. Tulis, vice president of sales. Finuf joined Beaird in 1935 in the pattern shop and served throughout the plant, moving up to plant engineer, superintendent of the machine shop, the forge plant, tank divisional sales manager and assistant sales manager before his appointment as assitant general manager of sales in 1946.

A-C Names Malick, Spargo To New Posts at Houston

K. D. Malick and L. H. Spargo have been appointed manager of petroleum and chemical sales, and of general industrial sales, respectively, in the Houston district office of Allis-Chalmers Industries Group.

Malick has been with Allis-Chalmers since 1939, having been a sales representative in the Houston district since 1947. Spargo joined Allis-Chalmers in 1942. He has been a sales representative in the Houston district 10 years.

Homco Departments to Be United in New Structure

A new structure being built adjacent to the main plant of Houston Oil Fields Materials Co., Inc., at Houston will house several departments of the company. Completion of the 40 by 100-ft. unit is expected about mid-July.

It will be occupied by Homco's electrical well servicing department, the electrical research and development lab, electrical well service production lab and the maintenance lab for electrical well service units.

Milwhite Drilling Mud Plant Being Constructed

Drilling mud for oil and gas wells being drilled in the New Orleans area will be produced by Milwhite Mud Sales Co.'s $1-million plant under construction along the Industrial Canal near the Chef Menteur Highway. Completion of the plant is expected in October.

McCullough Opens Service Branch at Monahans, Tex.

McCullough Tool Co. has opened a service branch at Monahans, Tex., according to O. J. McCullough, vice president. Branch Manager J. D. Epperson is in charge of operations at this branch, which is fully equipped to serve the area with all wire-line services offered by McCullough Tool.

Infilco's New Department Headed by G. E. Hauer

Formation of a new department of Infilco, Inc., in response to increasing interest in industrial water and waste treatment and appointment of G. E. Hauer to head its activities has been announced by E. G. Kominek, vice president and general sales manager.

Hauer was engineer and chemist for the city of Grand Rapids, Mich., before he joined the general chemical division of Allied Chemical & Dye Corp. Most recently he has been vice president of American Well Works.

The new division of Infilco will handle the special applications of the company's equipment for liquids treatment in the industrial field. Working closely with Infilco's research and development department, the new division will study marketing techniques and special promotion of developments in the fields of water and waste treatment.

Climax Changes Company Name, Moves Dallas Office

Climax Engine Manufacturing Co., a division of Eversharp, Inc., is the new name of a leading manufacturer of industrial gas engines. The company was formerly known as Climax Engine & Pump Manufacturing Co.

The district office at Dallas, Tex., has been moved to the Tower Petroleum Building. The company has general sales offices at Chicago and a factory at Clinton, Iowa. Distributors are located throughout the United States and Canada.

Schlueter Fellowship At OU Is Renewed

William A. Schlueter, formerly president of Refinery Supply Co., Tulsa, has renewed the $1,000 William Earl Schlueter Memorial fellowship at the University of Oklahoma. First awarded in 1948, the fellowship is for a graduate student in chemistry.

Dr. George L. Cross, president of OU, said "It is because of the interest of men such as Mr. Schlueter that it is possible for the University of Oklahoma to continue to show progress in our work."

Ideco Appoints Cook

W. O. (Bill) Cook has been appointed Ideco, Inc.'s, senior vice president in charge of engineering and manufacturing. The appointment was announced by George W. Walton, president of Ideco, Inc., Dallas, Tex.

Republic Names Brackett To Denver Sales Post

John W. Brackett has been assigned to Denver, Colo., as sales office representative by Refinery Supply Co. Brackett was formerly employed by Cummins Sales & Service, Gates Rubber Co., and came to Republic Supply Co. from Carson Machine & Supply Co.

Schutte & Koerting Names Johns as Sales Engineer

Leo Johns has been appointed sales representative for Oklahoma and sections of Arkansas and Texas by Schutte & Koerting Co., Cornwells Heights, Bucks County, Pennsylvania.

Johns will give sales and engineering service in this area for all SK products.

DeSilva Named IBM Special Petroleum Representative

J. R. DeSilva has been appointed special representative in the petroleum department of International Business Machines Corp., covering the company's midwestern sales region. DeSilva will coordinate sales activities and planning of applications of IBM equipment to meet customer needs in the petroleum field. He will also conduct classes for customer personnel and seminars for IBM sales representatives to keep them abreast of new machine accounting and data processing techniques in the petroleum field.

DeSilva joined IBM in a sales post in New Orleans and has served as accounting machine sales manager in Mobile, Ala.

Consolidated Shipyard Completes Third Year

Gus Glasscock, Sr., has organized Consolidated Shipyard, Inc., another new and vigorous industrial venture in Corpus Christi, based largely on marine oil activity.

The Consolidated Shipyard, which did not celebrate its third birthday until April, already has built 10 vessels, is in the process of constructing two work boats, has completed a drilling barge for bay duty, and has begun construction of 14 service vessels.

Consolidated Shipyard occupies four acres at the west end of the Corpus Christi Turning Basin. Facilities now consist of a 50 by 150-ft. metal building and a vertical lift capable of handling up to 100 tons. New launching ways are being built.

Otis Engineering Reassigns Two Division Managers

Bob Crain, manager of Otis Engineering Corp.'s Oklahoma City division, has been transferred to Corpus Christi as division manager. Duane Johnson, superintendent for the Otis division in New Iberia, has been promoted to district manager in Oklahoma City to replace Crain.

Crain replaces W. K. Waters who has been assigned to Otis' South American subsidiary, Servicio Tecnico de Pozos "Otis" C.A. He will be assigned to the Otis camp at Lake Maracaibo, Venezuela.

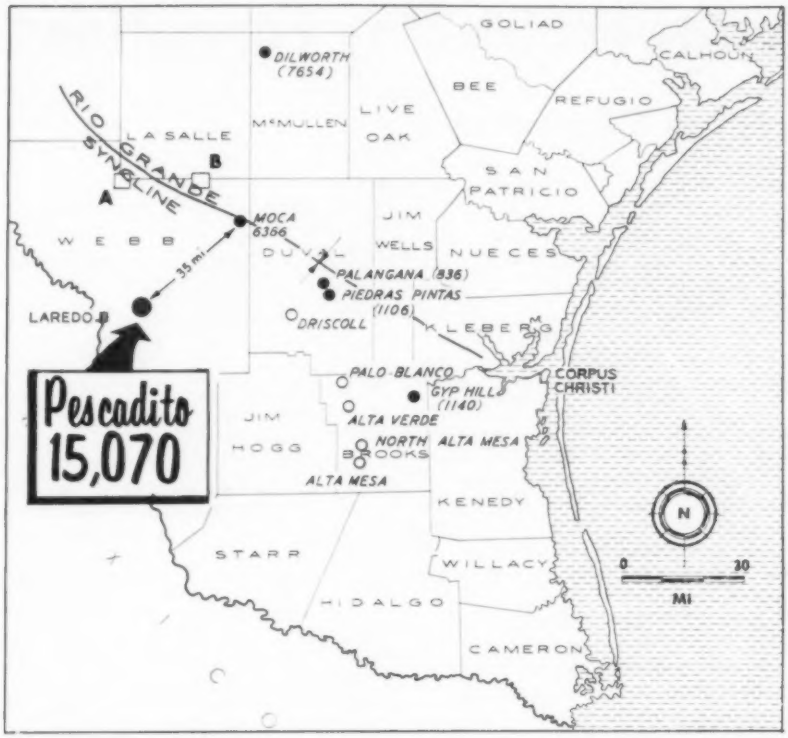
Prior to his transfer to Oklahoma City, Crain was district manager for Otis in Longview. Johnson has also been stationed in the Otis branches in Houma, Victoria, and Corpus Christi.

Roebling Royal Blue Wire Rope goes to any length to prove its **high strength!**

Every inch of every foot of Royal Blue is stronger than any rope you've ever used on *any* job. This on-the-job tenacity helps to make it the most widely and readily accepted rope in Roebling's history. It is but one of Royal Blue qualities that makes for its long service life—on any job you choose. For full details on Roebling Royal Blue Wire Rope talk to your distributor or write to Wire Rope Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey, for your copy of "*Wire Rope Recommendations and Catalog.*"

ROEBLING

Branch Offices in Principal Cities—Subsidiary of The Colorado Fuel and Iron Corporation



Ginther, Warren & Ginther penetrated a salt core at 15,070 ft. at 1 Killam, in Webb County, Texas, adding a sixth proven salt dome to the Southwestern salt basin, and revealing the deepest known salt core in Texas. Figures in parentheses show depth of salt at the previously known domes in South Texas; circles show domes where salt has not been found.

PESCADITO . . .

It's Texas' deepest salt dome

By Frank J. Gardner

WHAT IS PERHAPS the most important deep hole in South Texas' history has now apparently reached bottom in Webb County. And what it has revealed may have some vital effects on geologic thinking in that part of the country.

Ginther, Warren & Ginther 1 Killam was originally aimed at 17,500 ft. to test the Edwards limestone on the old Pescadito dome (OGJ, Mar. 25, p. 287). But it surprised many people, including a lot of geologists, by piercing a typical salt-dome cap rock and salt core at 14,396 ft. At that depth, the bit entered typical cap rock material—70 per cent anhydrite and 30 per cent shale; at 15,070 ft., the salt core was penetrated, and from that level to 15,107 ft. operators found 70 per cent crystalline salt and 30 per cent anhydrite.

Three records change . . . Thus South Texas gains another known salt dome for its Southwestern salt basin, a new drilling-depth record for this part of the country, and a new Texas depth record for a salt core. This brings to six the number of such domes where salt has actually been penetrated (see map). At least five others are categorized as salt domes but have not yet seen the salt. A rule of thumb among South Texas operators is that any structure with more than 500 ft. of domal closure in this area should be classed as a "suspected salt dome." If this is applied, more than five such structures should be included, but other qualifying elements also must be considered, such as radial fault patterns, surface indications, etc.

The deepest salt plug previously known was the one at Raccoon Bend, in Austin County on the upper Texas Gulf Coast. Here, salt was penetrated at 11,440 ft., Humble Oil & Refining Co., after drilling through 110 ft. of Cretaceous chalk, announced the discovery in 1946 at its Y-16 Sherrod.

Generally, only those domes where the salt core lies 6,000 ft. or more below the surface are designated as deep-seated, and only seven have been known to date in the upper Texas coast; Pescadito is the third one for South Texas.

And a belief is confirmed . . . The Pescadito well did not find its Edwards objective; at 12,900 ft., it topped the Georgetown-Lower Cretaceous, and in that formation found 1,500 ft. of fractured limestone with definite showings of gas. Operators will test this section in hopes of making a gas well of the 1 Killam. If this happens, it will be the first producer for this long-known surface uplift.

South Texas operators have been drilling it for 22 years in a frustrating search for pay. They knew that it had every characteristic of a salt dome, and this knowledge, coupled with the many shows of oil and gas in Tertiary beds above the Cretaceous, kept Pescadito high on the list of potential prospects. Similar prospects, less thoroughly explored, lie at A and B on the map, and it is likely that the revelation at Ginther, Warren & Ginther 1 Killam will lead to further exploration of these.

But unknowns remain . . . Whether the deep hole is a success or not, however, it should generate some new thought among South Texas oil finders. There is much to be learned about the deep-seated dome . . . its true regional effect, its relationship to deep-sand porosities, and most important of all, its oil-trapping effects in shallower beds. So far, the caps and crests of the truly deep salt cores have not proved to be prolific sources of production. But on their flanks, there must be much undiscovered oil. In the words of Levorsen, perhaps we'd best "get off the top of the structure."

Arkansas, New Mexico, Mississippi, Louisiana . . .

A History of Southwestern Pay Formations

By Frank E. McGonagill, Jr.

THE BOOKLET entitled "Oil Production History of the Southwest," prepared by the oil and gas department of the Bank of the Southwest, presents statistical information on important oil-producing formations in seven southwestern states. Its basic data were obtained from "Statistics of Oil and Gas Development and Production," Vol. 9, published by the American Institute of Mining and Metallurgical Engineers—Petroleum Branch. Additional data were obtained from Yearbook 1955 of the National Oil Scouts and Landmen's Association.

Arkansas

In the Arkansas section, the booklet covers data on 14 formations. Cumulative production through 1954 is given on 170 fields, showing a total of 857,773,698 bbl. At the end of 1954, average cumulative field production for the formations presented was 5,814,397 bbl.; average cumulative recovery per acre was 2,862 bbl.; with an average cumulative acre-foot recovery of 204 bbl.

From these fields, the 1954 total production was 24,616,091 bbl. or approximately 83 per cent of the total state production for that year, with an average field production of 144,800 bbl. for the same period.

El Dorado South field of Union County was established as having the earliest production in Arkansas from the formations covered in this summary. This field has been producing from the Nacatoch formation since 1920.

From the standpoint of cumulative production, the Graves formation of the Upper Cretaceous age is the most prolific, having produced 442,507,400 bbl. through 1954. This formation also had the greatest average field cumulative production at the end of 1954, averaging 55,313,425 bbl. per field, with the per acre and per acre-foot recoveries through 1954 being 7,472 bbl. and 257 bbl., respectively.

The formations containing the greatest number of fields are the Cotton Valley and the Reynolds formations of Jurassic age claiming 24 fields each. Through 1954, these fields had an average cumulative field production of 3,138,872 bbl., and 6,720,741 bbl., respectively.

In recoveries per acre, the Graves formation is in the lead in Arkansas, while the Paluxy formation leads in recoveries per acre-foot. Average cumulative production in these categories through 1954 was 7,472 bbl. per acre from the Graves formation, and 342 bbl. per acre-foot from the Paluxy formation.

Since complete information was not available, it was impossible to compare the productive area or number of wells for the various formations. The average cumulative recoveries per acre and per acre-foot shown were calculated only from those fields with sufficent information to do so.

Two tables are included with this summary of the data. Table 1 presents the relative importance of the various formations with respect to order of discovery, number of fields, production to the end of 1954, production during 1954, and cumulative production through 1954 of barrels per acre, barrels per acre-foot, and average recovery per field. Table 2 contains the total and averages of the various formations.

New Mexico

The New Mexico section of the booklet contains data on 10 formations. It covers a total of 110 fields with a cumulative production through 1954 of 315,969,494 bbl. At the end of 1954, average cumulative field production for the formations presented was 2,313,136 bbl.; average cumulative recovery per acre was 1,111 bbl.; with an average cumulative acre-foot recovery of 57 bbl.

The 1954 total production from these fields was 26,591,652 bbl. or approximately 35 per cent of the total state production for that year. During the same period, the average field production was 241,742 bbl.

The earliest production in New Mexico from formations covered in this summary was established in Getty field of Eddy County, which has been producing from the Yates (Permian) formation since 1927.

The most prolific formation from the standpoint of cumulative production is the San Andres formation of Permian age, which had produced 161,109,146 bbl. through 1954. In addition, the San Andres (Permian) formation had the greatest average field cumulative production at the end of 1954, averaging 8,479,429 bbl. per field, the San Andres per acre and per acre-foot recoveries through 1954 were 1,402 bbl. and 29 bbl., respectively.

The San Andres formation of Permian age boasted 19 fields, which was the greatest number of fields.

The Simpson formation of Ordovician age leads New Mexico in recoveries per acre. The Yates formation of Permian age leads in recoveries per acre-foot. Average cumulative production in these categories through 1954 was 2,435 bbl. per acre and 172 bbl. per acre-ft.

Total production during 1954 was led by the Yeso (Permian) formation with a total production for the year of 5,930,615 bbl. Per field production was led by the Simpson (Ordovician) formation with a total of 659,714 bbl.

It is not possible to compare the productive area or number of wells for the various formations since complete information was not available. The average cumulative recoveries per acre and per acre-foot shown were calculated only from those fields with sufficient information to do so.

Two tables are included with this summary. Table 1 presents the relative importance of the various formations with respect to order of discovery, number of fields, production to

Author is a petroleum engineer in the oil and gas department of the Bank of the Southwest, and is also a vice president of the bank.

LAST OF THREE PARTS

PART 1—Texas Oil Formations, November 19, 1956, page 220.

PART 2—Oklahoma Oil Formations, May 6, 1957, page 179.

Table 1—Relative Importance of Principal Producing Formations

ARKANSAS

Rank	Order of discovery	Number of fields	Production to end of 1954	Production during 1954	Through 1954: Cum. recovery per acre, bbl.	Through 1954: Cum. recovery per acre-ft., bbl.	Through 1954: Avg. cum. recovery per field, bbl.
1	Nacatoch	Cotton Valley	Graves	Reynolds	Graves	Paluxy	Graves
2	Graves	Reynolds	Reynolds	Graves	Reynolds	Hosston	Reynolds
3	Blossom	Hosston	Nacatoch	Cotton Valley	Hogg Sd.	Hogg Sd.	Nacatoch
4	Sligo	Nacatoch	Cotton Valley	Hogg Sd.	Cotton Valley	Reynolds	Hogg Sd.
5	Hosston	Pettet	Hosston	Hosston	Hosston	Graves	Cotton Valley
6	Paluxy	Rodessa	Blossom	Pettet	Paluxy	Sligo	Blossom
7	Tokio	Meakin	Hogg Sd.	Nacatoch	Blossom	Cotton Valley	Hosston
8	Cotton Valley	Paluxy	Rodessa	Meakin	Nacatoch	Meakin	Rodessa
9	Reynolds	Tokio	Tokio	Tokio	Pettet	Blossom	Tokio
10	Rodessa	Graves	Pettet	Rodessa	Sligo	Pettet	Paluxy
11	Pettet	Tuscaloosa	Paluxy	Blossom	Tokio	Tokio	Pettet
12	Meakin	Blossom	Meakin	Tuscaloosa	Meakin	Tuscaloosa	Meakin
13	Hogg Sd.	Hogg Sd.	Sligo	Paluxy	Tuscaloosa	Nacatoch	Sligo
14	Tuscaloosa	Sligo	Tuscaloosa	Sligo	Rodessa	Rodessa	Tuscaloosa

NEW MEXICO

1	Yates	San Andres	San Andres	Yeso	Simpson	Yates	San Andres
2	San Andres	Yates	Yeso	Wolfcamp	Yates	Queen	Yeso
3	Grayburg	Yeso	Grayburg	San Andres	San Andres	Seven Rivers	Simpson
4	Seven Rivers	Queen	Seven Rivers	Simpson	Abo	Grayburg	Grayburg
5	Delaware	Seven Rivers	Yates	Grayburg	Grayburg	Wolfcamp	Seven Rivers
6	Queen	Grayburg	Simpson	Abo	Wolfcamp	Simpson	Wolfcamp
7	Yeso	Wolfcamp	Wolfcamp	Queen	Yeso	Abo	Yates
8	Simpson	Abo	Queen	Seven Rivers	Seven Rivers	Delaware	Queen
9	Abo	Delaware	Abo	Yates	Queen	Yeso	Abo
10	Wolfcamp	Simpson	Delaware	Delaware	Delaware	San Andres	Delaware

MISSISSIPPI

1	L. Tuscaloosa	Wilcox	L. Tuscaloosa	L. Tuscaloosa	Baker	Baker	L. Tuscaloosa
2	Eutaw	L. Tuscaloosa	Eutaw	Wilcox	L. Tuscaloosa	L. Tuscaloosa	Eutaw
3	Baker	Eutaw	Wilcox	Eutaw	Eutaw	Wilcox	Baker
4	Wilcox	Baker	Baker	Baker	Wilcox	Eutaw	Wilcox

LOUISIANA

1	Wilcox North	U. Miocene	U. Miocene	U. Miocene	U. Miocene	Wilcox North	U. Miocene
2	U. Miocene South	L. Miocene	L. Miocene	L. Miocene	L. Miocene	Tuscaloosa	Wilcox North
3	Paluxy North	Wilcox North	Wilcox North	Wilcox North	Cockfield	Wilcox South	L. Miocene
4	L. Miocene South	Cockfield	Wilcox South	Wilcox South	Wilcox South	L. Miocene	Wilcox South
5	Cockfield South	Wilcox South	Cockfield	Cockfield	Wilcox North	U. Miocene	Cockfield
6	Wilcox South	Tuscaloosa	Tuscaloosa	Tuscaloosa	Tuscaloosa	Cockfield	Tuscaloosa
7	Schuler North	Schuler	Paluxy	Schuler	Schuler	Tuscaloosa	Paluxy
8	Tuscaloosa	Paluxy	Schuler	Paluxy	Paluxy	Paluxy	Schuler

the end of 1954, production during 1954, and cumulative production through 1954 of barrels per acre, barrels per acre-foot, and average recovery per field, and Table 2 contains the totals and averages of the various formations.

Mississippi

The section on Mississippi contains data on four formations and covers a total of 118 fields with a cumulative production through 1954 of 273,190,584 bbl. At the end of 1954, average cumulative field production for the formations presented was 4,031,487 bbl.; average cumulative recovery per acre was 2,923 bbl.; with an average cumulative acre-foot recovery of 220 bbl.

The 1954 production from these fields was 27,168,410 bbl. or approximately 79 per cent of the total state production for that year and for the same period, the average field production was 230,241 bbl.

The earliest production in Mississippi from formations covered in this summary was established in Brookhaven field of Lincoln County, which has been producing from the Lower Tuscaloosa formation since 1943.

The lower Tuscaloosa formation of Upper Cretaceous age, which had produced 143,932,499 bbl. through 1954, is the most prolific formation from the standpoint of cumulative production. It has also been established that the lower Tuscaloosa formation had the greatest average field cumulative production at the end of 1954, averaging 6,853,929 bbl. per field. The lower Tuscaloosa per acre and per acre-foot recoveries through 1954 were 3,726 bbl. and 219 bbl., respectively.

The greatest number of fields is in the Wilcox (Eocene) formation of Mississippi, having some 78 fields and with an average cumulative field production through 1954 of 425,315 bbl.

The leading formation in Mississippi in recoveries per acre and per acre-foot is the Baker Wilcox formation of Eocene age. Average cumulative production in these categories through 1954 from the Baker Wilcox was 4,218 bbl. per acre and 362 bbl. per acre-ft.

(Tables continued on pages 192-193)
(Text continued on page 194)

Source of material . . .

Basic data were obtained from "Statistics of Oil and Gas Development and Production," Vol. 9, published by petroleum branch of A.I.M.M.E. and additional data were obtained from Yearbook 1955 of National Oil Scouts and Landmen's Association.

Table 2–Principal Producing Formations of Arka

ARKANSAS

Formation and year of discovery—	No. of fields	Area proved, acres	Production to end of 1954	Production during 1954	Wells producing Dec. 1954	Gravity, °A.P.I.	Avg. net productive thickness (ft.)	Acre-feet	Through 1954 — Cumulative recovery — Per acre (bbl.)	Per ac.-ft. (bbl.)	Recovery avg. per field (bbl.)
Blossom (Upper Cretaceous)—1928:											
Totals	7	3,665	19,069,250	452,449	118			2,400			
Averages						26	10		2,374	190	2,724,179
Cotton Valley (Jurassic)—1937:											
Totals	24	7,955	75,332,927	3,170,996	154			174,880			
Averages						38	15		3,202	215	3,138,872
Graves (Upper Cretaceous)—1925:											
Totals	8	10,630	442,507,400	4,020,715	12			2,670			
Averages						24	8		7,472	257	55,313,425
Hogg (Lower Cretaceous)—1946:											
Totals	5	2,270	18,559,046	2,533,990	77			39,960			
Averages						37	13		3,739	266	3,711,809
Hosston (Lower Cretaceous)—1930:											
Totals	19	5,040	22,233,941	2,063,909	214			145,340			
Averages						34	15		2,964	276	1,170,207
Meakin (Upper Cretaceous)—1943:											
Totals	10	1,624	3,408,996	741,948	139			18,060			
Averages						22	10		1,522	197	340,900
Nacatoch (Upper Cretaceous)—1920:											
Totals	16	19,080	80,219,963	859,387	484			446,210			
Averages						23	28		2,090	112	5,013,748
Paluxy (Lower Cretaceous)—1932:											
Totals	9	1,260	4,929,784	357,274	24			9,330			
Averages						29	7		2,404	342	547,754
Pettet (Lower Cretaceous)—1942:											
Totals	13	6,180	6,337,106	1,118,379	91			82,530			
Averages						37	11		1,752	151	487,470
Reynolds (Jurassic)—1937:											
Totals	24	12,560	161,297,781	7,431,811	284			678,121			
Averages						37	23		6,688	260	6,720,741
Rodessa (Lower Cretaceous)—1937:											
Totals	13	3,360	15,158,430	665,049	83			49,710			
Averages						38	16		1,075	70	1,166,033
Sligo (Lower Cretaceous)—1929:											
Totals	5	450	978,386	90,220	28			3,825			
Averages						28	10		1,750	239	195,677
Tokio (Upper Cretaceous)—1936:											
Totals	9	1,300	6,972,430	698,166	83			18,970			
Averages						19	10		1,537	140	774,714
Tuscaloosa (Upper Cretaceous)—1951:											
Totals	8	560	768,258	411,798	14			6,110			
Averages						35	9		1,495	138	96,032
Total all formations	170	75,934	857,773,698	24,616,091	1,805			1,678,116			
Avg. all formations						31	13		2,862	204	5,814,397

NEW MEXICO

Abo (Permian)—1948:											
Totals	6	2,800	4,453,489	1,844,506	60			243,700			
Averages						39	50		1,203	38	742,248
Delaware (Permian)—1937:											
Totals	5	1,360	367,247	95,016	26			17,080			
Averages						40	10		223	31	73,449
Grayburg (Permian)—1929:											
Totals	10	13,280	28,123,211	2,310,653	303			646,046			
Averages						35	24		1,142	56	2,812,321
Queen (Permian)—1938:											
Totals	12	15,000	9,154,300	1,512,378	338			168,800			
Averages						36	14		562	62	762,858

nsas, New Mexico, Mississippi, and Louisiana

Formation and year of discovery—	No. of fields	Area proved, acres	Production to end of 1954	Production during 1954	Wells producing Dec. 1954	Gravity, °A.P.I.	Avg. net productive thickness (ft.)	Acre-feet	Through 1954 — Cumulative recovery — Per acre (bbl.)	Per ac.-ft. (bbl.)	Recovery avg. per field (bbl.)
San Andres (Permian) 1928:											
Totals	19	19,327	161,109,146	4,389,749	464			1,432,829			
Averages						32	29		1,402	29	8,479,429
Seven Rivers (Permian) 1929:											
Totals	12	12,968	18,209,281	742,926	304			359,520			
Averages						34	15		773	61	1,517,440
Simpson (Ordovician) 1947:											
Totals	5	5,560	14,130,218	3,298,571	122			326,800			
Averages						42	68		2,435	41	2,826,043
Wolfcamp (Permian) 1950:											
Totals	10	7,000	12,360,943	5,846,920	171			163,640			
Averages						42	28		1,103	52	1,236,094
Yates (Perm.)—1927:											
Totals	17	5,960	14,285,285	620,318	130			56,720			
Averages						29	10		1,428	172	840,311
Yeso (Permian)—1944:											
Totals	14	31,080	53,776,374	5,930,615	733			1,330,160			
Averages						40	34		838	30	3,841,170
Total all formations	110	114,335	315,969,494	26,591,652	2,651			4,745,295			
Avg. all formations						37	28		1,111	57	2,313,136
MISSISSIPPI											
Baker (Wilcox, Eocene)—1946:											
Totals	4	2,090	13,315,290	1,333,596	81			10,840			
Averages						39	8		4,218	362	3,328,823
Eutaw (Upper Cretaceous)—1944:											
Totals	15	22,085	82,768,215	6,634,019	506			733,795			
Averages						25	22		2,366	82	5,517,881
Lower Tuscaloosa (U. Cret.)—1943:											
Totals	21	23,152	153,932,499	12,247,474	465			857,164			
Averages						41	20		3,726	219	6,853,929
Wilcox (Eocene)—1946:											
Totals	78	16,870	33,174,580	6,953,321	411			132,562			
Averages						39	7		1,382	218	425,315
Total all formations	118	64,197	273,190,584	27,168,410	1,463			1,734,361			
Avg. all formations						36	14		2,923	220	4,031,487
LOUISIANA (North)											
Paluxy (Lower Cretaceous)—1929:											
Totals	8	3,440	839,152	32,820	10			32,560			
Averages						44	9		156	21	104,894
Schuler (Jur.)—1942:											
Totals	9	2,816	269,574	75,617	2			110,360			
Averages						48	44		339	18	29,953
Tuscaloosa (U. Cretaceous)—1945:											
Totals	11	1,340	3,413,838	367,928	21			27,260			
Averages						44	16		1,224	106	310,349
Wilcox (Eocene)—1925:											
Totals	45	38,015	147,997,777	9,660,605	989			2,462,320			
Averages						40	23		1,589	119	3,288,839
(South)											
Cockfield (Eoc.)—1938:											
Totals	19	5,040	15,601,238	1,078,573	46			155,960			
Averages						48	32		2,091	79	821,118
Miocene (L.)—1931:											
Totals	65	14,150	180,803,204	14,606,801	504			2,934,880			
Averages						43	78		5,481	97	2,781,588
Miocene (U.)—1926:											
Totals	128	105,845	1,141,627,484	117,793,360	2,360			19,068,315			
Averages						39	158		6,871	90	8,918,965
Wilcox (Eocene)—1940:											
Totals	15	6,710	24,592,683	1,648,643	75			1,527,060			
Averages						47	44		1,988	98	1,639,512
Total all formations	300	177,356	1,515,144,950	145,264,347	4,007			26,318,715			
Avg. all formations						44	50		2,467	78	2,236,902

During 1954, total production and per-field production was led by the lower Tuscaloosa formation with a total production for the year of 12,247,474 bbl. and a per-field production of 583,213 bbl.

It is not possible to compare the productive area or number of wells for the various formations since complete information was not available. The average cumulative recoveries per acre and per acre-foot shown were calculated only from those fields with sufficient information to do so.

Two tables are included with this summary. Table 1 represents the relative importance of the various formations with respect to order of discovery, number of fields, production to the end of 1954, production during 1954, and cumulative production through 1954 of barrels per acre, barrels per acre-foot, and average recovery per field. Table 2 contains the totals and averages of the various formations.

Louisiana

This booklet contains data on eight formations in Louisiana. These eight formations cover a total of 300 fields having a cumulative production through 1954 of 1,515,144,950 bbl. At the end of 1954, average cumulative field production for the formations presented was 2,236,902 bbl.; average cumulative recovery per acre was 2,467 bbl.; with an average cumulative acre-foot recovery of 78 bbl.

During 1954, the total production from these fields was 145,264,347 bbl. or about 60 per cent of the total state production for that year; and, for the same period, the average field production was 484,214 bbl.

The Wilcox N. (Eocene) formation in Tullos-Urania-Georgetown field in LaSalle, Grant, and Winn parishes, has been producing since 1925 and is the earliest formation covered by this summary to produce in Louisiana.

The Upper Miocene formation, which had produced 1,141,627,484 bbl. through 1954, is considered the most prolific formation in Louisiana from the standpoint of cumulative production. The Upper Miocene formation also had the greatest average field cumulative production at the end of 1954, averaging 8,918,965 bbl. per field, with per-acre and per acre-foot recoveries through 1954 of 6,871 bbl. and 90 bbl., respectively.

The records indicate 128 fields in the Upper Miocene formation which is the greatest number of fields for any one formation in Louisiana. These fields had an average cumulative field production through 1954 of 8,918,965 bbl.

The Upper Miocene formation leads Louisiana in recoveries per acre. The Wilcox Eocene North leads in recoveries per acre-foot. Average cumulative production in these categories through 1954 from the Upper Miocene was 6,871 bbl. per acre, and from the Wilcox Eocene North, 119 bbl. per acre-ft.

Total production and per field production during 1954 was led by the Upper Miocene formation with a total production for the year of 117,793,360 bbl. and a per field production of 920,261 bbl.

It is not possible to compare the productive area or number of wells for the various formations since complete information was not available. The average cumulative recoveries per acre and per acre-foot shown were calculated only from those fields with sufficient information to do so.

Two tables are included with this summary. Table 1 presents the relative importance of the various formations with respect to order of discovery, number of fields, production to the end of 1954, production during 1954, and cumulative production through 1954 of barrels per acre, barrels per acre-foot, and average recovery per field. Table 2 contains the totals and averages of the various formations. **End.**

WHAT'S HE PUTTIN' IN THE HOPPER?
SEECO-MUL EMULSIFIER— MAKES BETTER HOLE CONDITIONS ... DRILLS FASTER ... GIVES MORE TIME ON BOTTOM
"SEECO-MUL MAKES A GOOD MUD BETTER"
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EXPLORATION HIGHLIGHTS

APPALACHIAN

EASTERN KENTUCKY

In Wolfe County and located on Holly Creek in the Landsaw Quadrangle, United Carbon Co. have completed their rank wildcat 1 Blaine Rose. Operators drilled to a total depth of 4,777 ft. in Knox dolomite and then plugged back to 3,830 ft. to test St. Peter sand from 3,760 to 3,790 ft. Well flowed initially at the rate of 622,000 cu. ft. of gas daily after fracture. Rock pressure was 1,275 psi. and the gas is reportedly sulfurous.

PENNSYLVANIA

East Whitfield Wildcat Testing

In East Whitfield Township, Indiana County, Southwest Pennsylvania, Columbian Carbon Co. 1-1839 Sam Hutchinson wildcat, topped the chert at 8,144 ft. Gas was encountered and tested 56,000 cu. ft. It is being tested after fracture. The depth of the hole is 8,388 ft.

● In Young Township, Manufacturers Light & Heat Co. 3-4426 R. & P. Coal Co. is running 7-in. casing at 7,257 ft.

WEST VIRGINIA

Greenbrier County Wildcat Is Dry

In Falling Springs district, Greenbrier County, West Virginia, Columbian Carbon Co. 1-1247 Cherry River Boom & Lumber Co., wildcat, elevation 2,884 ft., was dry after fracture. Big Lime 1,620 ft., Benson 4,519-70 ft., gas show 4,539 ft. Total depth 4,667 ft.

OHIO

New Activity Reported In Sego Pool

Renewed interest is being shown in Sego pool in Madison Township, Perry County. Trenco Oil Co. 1 Z & W Railroad Co., Section 15, found the Clinton at 3,088-3,149 ft. with 3 bbl. natural and 287 bbl. in a 24-hour test after fracture.

● The pool at Spring Mountain was widened 1,000 ft. to the west by Contract Drilling Co. 1 Laura Shellhorn, Section 7, Monroe Township, Coshocton County. Clinton was logged at 3,306-52 ft. and gaged 50 bbl. oil and 1,000,000 cu. ft. gas after fracture.

● East Ohio Gas extended their gas-producing area in Baughman Township, Wayne County, ¼ mile to the east by their completion on 1 Howard Otto, Section 1. Clinton sand at 3,862-83 ft. gaged 700,000 cu. ft. natural and 1,225,000 cu. ft. after fracture.

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CALIFORNIA

West Biggs Offset Completed

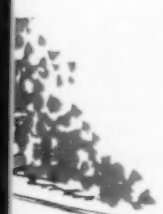
Humble Oil & Refining Co. has completed a north offset to the West Biggs gas field discovery in Butte County,

drill a gauge-sized hole...control heaving and sloughing with Seeco-Mul

One of the reasons for the current trend toward emulsion muds is the better hole conditions the systems afford. In almost all areas, emulsion muds increase drilling rates, make better hole conditions, drill into pay formations better, afford better coring, and protect the pay zone from water more effectively. Such factors are easily projected into substantial cost and time savings.

A Seeco-Mul mud has an exceptionally low filtration rate because the oil in the emulsion is effectively dispersed and the pores of the filter cake are plugged by a tough film. Holes can be drilled more nearly to gauge, with fewer and smaller washed-out areas. A hole drilled to gauge size also requires less mud, and less cement for the oil string. Seeco-Mul builds up a tough, thin wall cake which reduces fluid loss and sloughing and heaving in shale formations. And once a Seeco-Mul emulsion mud system is established, no special maintenance is required; only routine testing and treating is necessary.

In some fields, Seeco-Mul has reduced mud costs and rig time by as much as one-half over ordinary muds. Using Seeco-Mul might do as much for your drilling programs, too. Ask your mud dealer, or write to us. We'll be glad to send you illustrated literature and a lab sample without obligation. Crossett Chemical Company Division of The Crossett Company, P. O. Box 271, Crossett, Arkansas.



Seeco-Mul *emulsion muds drill faster, better, save drilling costs*

northern California. The new completion, 2 Elna B. Schohr, was brought in flowing 2,250 M.c.f. daily from two intervals at 2,520-31 ft. and 2,568-88 ft. Total depth of the well, located in SW NE 14-18n-1e, is 5,830 ft. It is a little more than ½-mile north of 1 Elna B. Schohr, the discovery well completed last March.

Wheeler Ridge-Tejon Active

Richfield Oil Corp. has announced two locations in the Wheeler Ridge field. One will be a deep test of the Eocene in NW NW 27-11n-20w, on the northeast edge of the regular producing area. The other Richfield test will spud in soon less than ½-mile southwest of the recent JV sand completion in 36-11n-20w, some 2 miles southeast of the regular area.

At neighboring Tejon field to the east, Reserve Oil & Gas Co. announced plans to drill a 12,500-ft. Z-5 sand test about 1,500 ft. southeast of their 67-18 Butler-Wehr discovery completed in March about 3 miles north of Tejon field.

Mount Poso Find Completed

Intex Oil Co. reports 1-21 Bowles was completed on the pump for 22 bbl. daily of heavy crude for a new fault block discovery in the Dominion area of Mount Poso field, Kern County. Intex found the top of the oil sand at 1,499 ft. The well is about 1,500 ft. north of the nearest other producer in NW NW 21-26s-28e. Total depth is 1,511 ft.

CANADA

ALBERTA

Innisfail Discovery Is Important Strike

Canadian Oil Companies and its partners reportedly have made one of the most significant strikes in western Canada this year at the Innisfail area wildcat, 6 miles southwest of Innisfail and 60 miles due north of Calgary.

Unofficial reports state that the well has opened up 65 ft. of D3 reef pay, flowing oil at an hourly rate of 55 bbl. on tests, and is coring ahead to look at a section believed to be about 250 ft. thick.

The wildcat is White Rose-C&E 1-16 Innisfail on LSD 1, 16-35-1w5. It is the third well for Canadian Oil in this township and is the second oil strike. The initial discovery well is the 11-11 Innisfail, a basal Cretaceous strike.

The latest Innisfail discovery found the reef at 8,436 ft. and the bottom of the last test was reported at 8,501 ft.

BRITISH COLUMBIA

B. C. Gets Oil Field No. 6

The sixth oil discovery in British Columbia this year was reported late last week at a wildcat just 1¾ miles northeast of Fort St. John. The strike is Pacific Petroleums, Ltd., and Associates 93 Charlie Lake on LSD 13, 5-84-18w6.

The well flowed oil at the rate of 20 bbl. per hour on drill-stem test of the Gething-Lower Cretaceous at 3,320-40 ft. Final pipe recovery was 800 ft. of clean oil and 100 ft. of very gassy oil-cut mud.

This is the first free oil from the Gething formation in British Columbia. Previously this formation was known for its gas production. There is some Gething oil found in northwestern Alberta at Rycroft, 110 miles southeast of Charlie Lake. Operator is drilling ahead below 3,552 ft. at this Permo-Penn venture. It is reported that if the Permo-Penn is found at a favorable depth, the well will be taken down to the Devonian at about 12,000 ft.

There have been five discoveries

Grady D. Harris, Jr. Morrison G. Tucker

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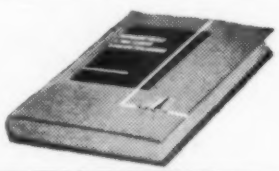

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of oil in B. C. this year . . . one at Imperial Oil, Ltd., 1-23-84-14 Alces in the Fort St. John area (it flowed 15 bbl. of oil per hour), Pacific Pete 88 Red Creek in the Fort St. John area (no completion data available as yet), Pacific Pete 1 Boundary Lake in the Boundary Lake area which is B. C.'s biggest oil producer to date). Hudson's Bay Oil & Gas Co. 1 Milligan Creek in the Big Arrow area, and Texaco Exploration Co. 6 Boundary Lake. All of these got their oil from the Triassic.

KANSAS

Flowing Discovery Reported in Kingman

A flowing Mississippian discovery in southern Kingman County was waiting on potential tests. It is Pickrell Drilling Co. 1 Wulf, SE SE NE 3-30s-7w, 1½ miles northeast of Rago and 1 mile north of Gilchrist pool.

The well gaged 17 bbl. of oil per hour on 35/64-in. choke on flow test from perforations at 4,160-80 ft.

LOUISIANA

NORTH LOUISIANA

Ouachita Wildcat Appears To Be Important Strike

An important North Louisiana oil and gas discovery appeared certain at a Ouachita Parish wildcat being drilled on a 5,000-acre block by Arkansas Louisiana Gas Co., of Shreveport.

Projected as a 9,875-ft. test of the Travis peak and Cotton Valley sands, the No. 1 Pipes estate, in Section 33-19n-1e, 15 miles west of Monroe, already has shown commercial gas and distillate production on drill-stem tests from three separate Travis peak sands, and the well is still drilling toward its objective in the Cotton Valley formation, expected in the next 1,000-ft. interval.

Electric log run recently indicated a total of 44 ft. of productive gas and distillate sands in Travis peak zones between 6,851 ft. and 8,746 ft. The log showed two additional zones which have not been drill-stem tested.

The well is approximately 6 miles northwest of Golson field, which produces oil from the Cadeville sand of the Cotton Valley, and 15 miles east of Ruston field, one of North Louisiana's major Cotton Valley gas-distillate fields.

Arkansas Louisiana has a 1,000 per cent interest in the well and the 5,000-acre block around it, and in addition has a 100 per cent interest in approximately 5,000 acres in the trend area.

On drill-stem test of the middle Travis peak from 7,189-7,205 ft., with tool open 50 minutes, the well flowed an estimated 1½ million cubic feet of gas per day on ¼-in. choke with 900 lb. flowing pressure.

Test of another middle Travis peak zone between 7,447 and 7,458 ft., with tool open 1 hour and with 1,000 ft. water cushion, showed gas at the rate of 800,000 cu. ft. per day, with top hole pressure of 525 lb. on ¼-in. choke.

On a 1-hour test of a lower Travis peak zone from 8,629-37 ft., with 2,000 ft. of water cushion, the well flowed at the rate of 750,000 cu. ft. per day on ¼-in. choke with 395 lb. top hole pressure.

All three gas zones showed distillate, but no estimate of production was made. Roberts Drilling Co., of Shreveport, is drilling the well.

SOUTH LOUISIANA

Weeks Island Production Spreads Into Iberia Parish

Completion of a well a mile southwest of previous production off the

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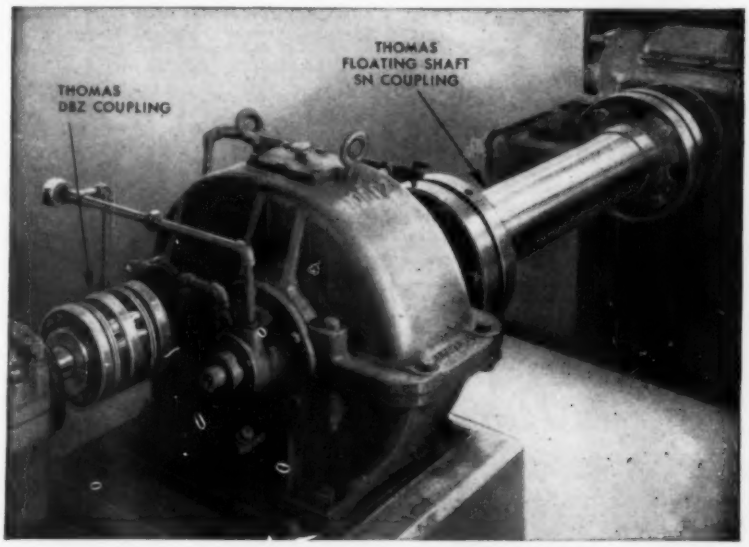

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southeast flank of the Weeks Island dome spreads development of ultra-deep sands around this dome across the border from Iberia into St. Mary Parish.

The extension is by Shell Oil Co. at its 1 J. M. Burgieres, Ltd., productive of gas and condensate from perforated interval at 16,126-37 ft. Tested through ⅞-in. choke for state potential, the well flowed at the rate of 4,078,000 cu. ft. of gas and 181 bbl. of 42.5°-gravity condensate per day. Pressure through that choke was 4,625 psi.

Pay is in hole drilled to 16,935 ft. It is the deepest production on that side of the dome, although prolific production at greater depths has been developed around other sides, principally off the north and northeast flanks, in Iberia Parish.

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Terrebonne Wildcat Opens New Gas-Condensate Area

Shell Oil Co. has a new gas-condensate discovery well 10 miles southeast of Houma, in Terrebonne Parish. It is its 1-A Peters, in 64-18s-18e, which flowed at the rate of 3,668,000 cu. ft. of gas and 141 bbl. of 49.4°-gravity condensate while testing through perforations at 11,283-11,306 ft. Flow was through ⅝-in. choke under pressure of 4,050 psi. Total depth is 12,835 ft.

Location is about 2½ miles northeast of South Houma field. This field, discovered by Shell in 1938, is oil-productive from 2 wells in sands at 10,160 ft. and 11,300 ft.

Cockfield Sand Produces In St. Landry Discovery

Cockfield sand is proving productive in a wildcat test drilled by Sohio Petroleum Co. northeast of Opelousas in St. Landry Parish. Perforated at 9,964-70 ft., it tested 237 bbl. of 45.7°-gravity oil per day through 5/32-in. choke Pay is the "B" sand. Hole had been drilled to 11,354 ft.

Flow during the test was under pressure of 2,450 psi. with gas-oil ratio of 3,375 cu. ft. per barrel.

The well opens a new field. It is 3 miles south of nearest production in Washington field, and about 3½ miles northeast of production at Opelousas field.

Wildcat Discovery Boosts Mosquito Bay Importance

The Mosquito Bay area, in southwestern Terrebonne Parish, took on additional importance with a gas-condensate discovery by Hassie Hunt Trust in a wildcat 2½ miles north of the area's previously completed 2 wells.

Hunt's well, 1 Nelson-State Lease 2785, is completed from perforated interval at 12,936-44 ft., a deeper pay for the area. Production through 5/32-in. choke was gaged at the rate of 2,000,000 cu. ft. of gas and 120 bbl. of 56°-gravity condensate per day. Pressure was 4,350 psi. Hole was drilled to 15,556 ft.

The area's discovery well, drilled by Forest Oil Corp., was completed in December 1955 as a gas-condensate producer at 10,266-72 ft. after drilling to 14,580 ft. It's other well, drilled by Shell Oil Co., was completed last August with production at 7,949-57 ft.

Pan American Petroleum Corp. is drilling on a 14,400-ft. test about 1½ miles southwest of the discovery well.

MICHIGAN

More Pay to Be Tested At Oceana Wildcat

Additional Reed City zone potential oil pay section will be drilled at Swan-King, Harvey et al 1 Skidmore, SW NE NE 15-16n-16w, Crystal Township wildcat, Oceana County.

Well showed for approximately 15 bbl. of oil a day natural from this pay section but swabbed only 23 bbl. of net oil in 8 hours after being shut in 16 hours following a 1,000-gal. acid treatment. No water showed.

About 9 ft. of saturated oil pay was drilled between 2,582-87 ft. in Reed City zone section at the 1 Skidmore. Hole filled at an average rate of 100 ft. of oil an hour on initial test. While some gas was in evidence both before and after acid treatment, not enough gas was showing to promote an oil flow after the semi-satisfactory acid treatment.

A Dundee pay zone, drilled between 2,498-2,508 ft., which showed for considerable gas and spray of oil through a hole full of Traverse water was cased off with 5-in. cemented in at 2,564 ft. before Reed City section was penetrated. This potential gas-oil pay zone may be perforated and tested further if the second pay level does not increase in its producing performance.

● First Salina test well in the old Diamond Springs Traverse oil pool, Heath Township, Allegan County, was coring this objective horizon. The Taggart Co. 1 Confer, SW NE NE 1-3n-14w, was being cored below 2,654 ft. First two cores cut in this section, between 2,620-54 ft. failed to show oil or gas saturation. Porosity was logged in the Detroit River zone with oil showing between 2,130-60 ft. Other porosity showed at 1,942-52 and 1,959-65 ft. Whether Taggaret would test this section in the event that Salina is dry was not announced.

NEW MEXICO

SOUTHEAST NEW MEXICO

Amerada Strike Completed In Northern Lea County

Amerada Petroleum Corp. 1-EC State, Devonian discovery in 16-11s-38e, flowed 607.89 bbl. of 48-gravity oil a day on completion test. The flow was through ¾-in. choke, from perforations at 12,021-97 ft.

Amerada's well opens another producing structure in the long north-south trend of Devonian fields along Lea County's northeastern border.

Phillips still testing . . . Phillips Petroleum Co. 1 Austin, deep prospect in 17-14s-36e, 3 miles northwest of Plainview, is continuing production tests in the Mississippian. After acidizing through perforations at 13,214-18 and 13,270-86 ft., the well gaged 3,283,000 cu. ft. of gas a day, plus 30 bbl. of oil and 9 bbl. of acid water.

East of Cross Roads . . . Lone Star Producing Co. 2 Santa Fe, ⅜-mile northeast of the opener of the Siluro-Devonian field 2 miles east of Cross Roads field, reported two drill-stem testh having oil shows on recovery.

On test at 12,163-71 ft., recovery was 90 ft. of clean oil, 270 ft. of heavily oil-cut mud and water blanket. At 12,168-77 ft., recovery was 70 ft. of free oil, 94 ft. of oil-cut mud and water blanket.

OKLAHOMA

NORTHWEST

Woodward County Wildcat Flows Chester Gas

Shell Oil Co.'s eastern Woodward County wildcat, the 1 Garvie in C NE NE 26-22n-17w, flowed 1,950 M.c.f. of gas per day on 1-in. choke during tests of the Chester lime-Mississippian at 7,238-58 and 7,294-7,314 ft.

Successful completion of this well would give the county its third producing area. The other two fields in the county produce gas-distillate from the Morrow sand.

Chester-Mississippian gas production is indicated at a rank Harper County wildcat, 8 miles southeast of the booming Southeast Stockholm area.

Rank Discovery Seen In Harper County

A Mississippian-Chester gas discovery was reported last week 8 miles from production in south-central Harper County. The well is Midwest Petroleum Co. 1 Cooper in NE SW 13-25n-22w.

A test at 7,210-7,490 ft. flowed gas at the rate of 6,380 M.c.f. per day. Casing is being run for production tests. This indicated strike is located southeast of the booming Southeast Stockholm field.

ROCKY MOUNTAIN

UTAH

Tohonadla Discovery Flows Hermosa Oil

The most westerly discovery in the Paradox basin campaign flowed oil at the rate of 1,450 bbl. per day on 8½-hour test of the Pennsylvanian at 4,990-5,050 ft. This newest San Juan County discovery is Shell Oil Co.'s 1 Tohonadla in the W½ SW SW 35-41s-21e.

TEXAS

WEST TEXAS

Gaines County Wildcat Flows Devonian Oil

Southeastern Gaines County apparently had another Devonian strike, 5

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Newest Gaines County Devonian discovery prospect. Honolulu Oil Corp. 1 Kinney was pulling tool after recovering oil on tests of the Devonian.

miles north of Arrow-Devonian field.

Honolulu Oil Corp. 1 C. F. Kinney, wildcat 12 miles southeast of Seminole in League 302, Block 1, Terry CSL Survey, flowed oil on its initial test of the Devonian. Operators reported top of the formation at 12,780 ft. A drill-stem test at 12,780-12,800 ft., open 10½ hours, surfaced gas, oil and water blanket in approximately 4 hours, then flowed 49 bbl. of oil the next 3 hours, and reversed out 172 bbl. of oil with no water.

No. 1 Kinney earlier had indicated production from the Wolfcamp and from the Strawn.

Signal Oil Co. 1 Ford, 25 miles southeast of Seminole, near the western border of Gaines County, also had Devonian oil prospects. A drill-stem test in Devonian rocks at 9,100-33 ft. recovered 800 ft. of oil and unloaded while coming out of the hole. A later test, at 9,133-88 ft., recovered 850 ft. of oil, 90 ft. of mud and 180 ft. of sulfur water.

Location is in Section 25, Block A10, PSL Survey, 3 miles south of San Andres production in East Hobbs field.

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TEXAS GULF

Louisiana Field Spreads Into Texas Coastal Area

Humble Oil & Refining Co. has extended South Louisiana's Merryville field into Texas.

Its extension well, 1 Lindsay, 6 miles northeast of Bon Wier, in Newton County, is just across the state line (Sabine River) from wells completed by Harry Bass and Atlantic Refining Co.

The location is ½ mile northwest of nearest producer. Louisiana production is in northwestern Beauregard.

Completion is in Sparta sand, a new producing horizon for the field. Pay is perforated at 7,200-10 ft. Wells on the Louisiana side produce from a 7,900-ft. upper Wilcox sand.

Tested through 5/32-in. choke, the well flowed at the rate of 60 bbl. of oil per day, registering pressure of 175 psi. on the tubing.

New Depth Record Set For Upper Texas Coast

A deep test drilled by Humble Oil & Refining Co. off the northeast flank of the large Moss Bluff dome, in southern Liberty County, has put the drilling depth record in the Upper Texas Gulf Coast district another 68 ft. deeper.

Humble's deep test, Robertson-McDonald, was drilled to 18,074 ft. Previous deepest test in this district was drilled by Phillips Petroleum Co. in Chocolate Bayou field, in Brazoria County. It went to 18,006 ft. before being plugged back for completion in one of the field's producing zones.

The Moss Bluff record breaker has been abandoned after plugging back to 10,522 ft. and attempting unsuccessfully to test showings at 10,492-10,508 ft. The location is more than a mile northeast of production on the dome. Deepest production so far is at 6,500-ft. in Frio sand.

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The unretouched photos on this page tell their own story of what happened to a Columbian Steel Building caught in the fury of that black funnel. Two roof panels and the door were ripped off. Building contents remained safe and almost undisturbed.

800 other homes and businesses, including every other building in that block, were damaged or destroyed, their contents blown away or ruined.

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The recently completed Ruskins Heights, Mo. shopping center after the tornado. Columbian Metal Building at right.

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		MONTANA GROUP: Lewis-Teapot				Teapot
		MONTANA GROUP: Mesaverde	Parkman			Campbell County
		MONTANA GROUP: Mesaverde	Sussex			Sussex West Sussex Meadow Creek
		MONTANA GROUP: Mesaverde	Shannon		Ash Creek	Dugout Sussex West Sussex Meadow Creek Ash Creek Teapot Cole Creek
		Eagle			Pumpkin Creek—Gas	
		COLORADO GROUP: Niobrara				Teapot
		COLORADO GROUP: Carlile and Upper Shales				Wakeman Flats Thornton Salt Creek
		COLORADO GROUP: Frontier-Wall Creek				Kara Billy Creek—Gas Sussex Meadow Creek Salt Creek Teapot Lance Creek
		Mowry Muddy-Newcastle				Bertha Moorcroft Osage Raven Glenrock Sherwin Clareton Trend Mush Creek Mush Creek Southwest Mush Creek West Lance Creek Sage Spring Creek Cole Creek
		Thermopolis				
	LOWER	Cloverly	Dakota			Donkey Creek Teapot Sage Spring Creek Cole Creek Glenrock Mush Creek Northwest Lance Creek
			Fuson			
			Lakota			Sussex West Sussex Meadow Creek Sherwood Salt Creek Mule Creek East Mule Creek West
JURASSIC		Morrison				Salt Creek Lance Creek
		Sundance				Salt Creek Lance Creek
TRIASSIC		Chugwater				
PERMIAN		Embar and Phosphoria				
PENNSYLVANIAN		Tensleep (West Side)				North Fork Sussex West Sussex Meadow Creek Salt Creek Teapot
		Minnelusa (East Side)				Adon Mitchell Creek Mule Creek East and West Lance Creek
		Lea Sands		Coffing		
MISSISSIPPIAN		NO PRODUCTION				
DEVONIAN		?				
SILURIAN		?				
ORDOVICIAN		NO PRODUCTION				
CAMBRIAN		NO PRODUCTION				

Clip and Save This Handy Correlator for Future Reference . . .

Here are the pay sands and producing areas in the Powder River basin . . . the scene of new Wyoming exploratory activity which stems from recent discoveries on the basin's northeast side.

Four Corners Correlator was published in OGJ, June 3, p. 185.

With 4-day retirement behind him . . .

. . . McIntyre Is Back in Action

THERE'S NOBODY in a bigger hurry to finish the Four Corners Pipe Line than Ralph G. McIntyre, even though he'll probably be out of a job soon after the last section of pipe goes in the ground.

It's not that McIntyre dislikes his job as president of Four Corners Pipe Line Co. The roguish grin splashed across his face is ample evidence to the contrary; "I'm enjoying myself," he says, and he obviously means it.

But for years McIntyre has been planning a second extended trip to Europe when he retires. He didn't quite make it the first time ("I was only retired 4 days"), so now he has the trip planned tentatively for the fall of 1958 "if the good Lord's with me."

Having reached the compulsory retirement age of 65, McIntyre stepped down as chairman of the board of Standard Oil Co. of Texas last January 31. At the same time, he gave up the presidency of Pasotex Petroleum Co. and Pasotex Pipe Line Co. All three firms are subsidiaries of Standard Oil Co. of California. McIntyre had been in the Standard of Cal family more than 46 years before his 4-day retirement.

On February 4 McIntyre was elected president of the newly formed Four Corners Pipe Line Co., which had just announced plans to build a $50,000,000 line to move crude oil from new fields in the Colorado - Utah - Arizona-New Mexico area to Los Angeles refineries. Standard of Cal has a 25 per cent interest in the new company.

Born in California, McIntyre joined Standard as a clerk in the accounting department at the Richmond, Calif., refinery in 1910. That was shortly after he "almost finished" high school.

He was transferred to Texas in 1928 as auditor of Pasotex Petroleum and Pasotex Pipe Line, both headquartered at El Paso. He has resided in Houston since 1946, when he was elected president of Standard of Texas. He was promoted to chairman of the board in 1955.

Full circle . . . His new job, McIntyre says, is "taking me back about 30 years." During his early days at El Paso, McIntyre recalls, he helped supervise construction of the first Pasotex pipeline moving West Texas crude to the Standard of Texas refinery there.

Although he's a little vague about his own education, McIntyre proudly recalls his close association with educators. His father was a school superintendent and his wife is an ex-teacher. McIntyre himself served on the city school board at El Paso for 7 years. Today, he considers a college education virtually essential for anybody going places in business.

"I still think there's only one way to get to the top," he philosophizes, "and that's by hard work. But a college education can make it a lot easier."

Mr. and Mrs. McIntyre have two children — Ralph, Jr., a Standard of Texas distributor at Roswell, N. M.; and Carolyn, whose approaching marriage has overshadowed the Four Corners project as far as the female members of the McIntyre household are concerned.

Construction of the Four Corners line started in mid-June. The entire system, some 750 miles in length, is expected to be finished next April or May.

And after that? "I'm not saying I'm retiring," says McIntyre. "I'm going to take some time off, I know." With luck, he hopes to work in that long-delayed trip before tackling another job.

P. P. Escoffier has left his position as general manager of Shell Italiana to become general manager of SAPPEUR, a new company formed to study a trans-European pipeline project.

Dr. Robert L. May has been promoted by Sinclair Refining Co. from assistant division director at the Harvey, Ill., research center, to assistant manager of lube-oil production with headquarters in New York.

Wayne Granger has resigned as geologist with Tidewater Oil Co. at Casper, Wyo., to become manager of a new McRae Oil & Gas Corp. subsidiary at Calgary. Granger formerly was with Brinkerhoff Drilling Co. in West Texas, Casper, and Denver.

Dr. Thomas Harrison Davies has been appointed a director of research of the Mellon Institute. Davies was associated with the University of Chicago before joining the institute in 1952.

Arthur R. Erickson has been promoted by Northern Natural Gas Producing Co. from chief geologist to exploration manager. Erickson was a geologist with Phillips Petroleum Co. before joining Northern Natural Gas in 1951. He is a graduate of the University of Oklahoma.

W. A. Whitmire, petroleum engineer with Union Pacific Railroad Co., has been transferred to Wilmington, Calif., from Denver. **William B. Kays, Jr.,** petroleum engineer at Rangely, Colo., has transferred to Denver to replace Whitmire. Kays will be succeeded by **B. M. Putnam,** petroleum engineer in the Rock Springs, Wyo., Rocky Mountain division office. **Glenn E. Thompson,** petroleum engineer in Wilmington, will succeed Putnam in Rock Springs.

Personals

F. K. Rader and **H. L. Stowers** have been elected vice presidents of Texas Gas Transmission Corp. Rader has been assistant to the executive vice president,

F. K. RADER

H. L. STOWERS

while Stowers was and will remain chief engineer. Rader has been with the company since early 1952, Stowers since 1943 including time with a predecessor firm, Memphis Natural Gas Co. In another move Texas Gas promoted **C. E. Coffey** from manager of its Jeffersontown, Ky., compressor station to superintendent of the Kentucky and Indiana division of the compressor department. The division includes eight stations.

Roland C. Smith, assistant to the regional exploration manager in Atlantic Refining Co.'s Dallas eastern region, has joined Ross Cabeen & Associates in Dallas as geologist **Joseph C. Roberts** has joined Cabeen in Lima, Peru. Roberts was formerly Shell Oil Co.'s district geologist in Corpus Christi, Tex.

R. H. Mansfield, Sohio Petroleum Co. staff geophysicist in the foreign operations division, has been appointed northwest division geophysicist. He will transfer from Oklahoma City to Billings, Mont. **H. C. Talley, Jr.,** staff geophysicist in Oklahoma City, will replace Mansfield in the foreign operations division. **C. C. Sellers,** superintendent of geophysical operations in Houston, will succeed Talley in headquarters exploration, Oklahoma City. **C. F. Wendenburg,** geophysical laboratory supervisor in Houston, will be acting superintendent of geophysical operations there.

J. A. Vickers, president of Vickers Petroleum Co., has been elected chairman of the newly formed Kansas Governor's Oil Advisory Committee. Other members appointed by Kansas **Gov. George Docking** are **Robert L. Williams,** Imperial Petroleum Co.; **Oliver Brown,** Liberal independent; **Harold Wamsley,** Hutchinson independent; **Chris Scheedy, Jr.,** Yates Center independent; **George Peterschmidt,** El Dorado Refining Co.; **Charles Byers,** Great Bend independent; **Jerry Driscoll,** Russell independent; and **Thomas H. Allan** and **Glenn Dunne, Sr.,** both Wichita independents. The committee held its first meeting last week.

George Adams has been appointed operations assistant to **Harry A. Brown,** D-X Sunray Oil Co.'s vice president in charge of manufacturing.

Charles J. Diver has been transferred by Ohio Oil Co. from Wyoming's Byron-Garland field, where he was engineer, to Tulsa as refinery engineer.

E. E. Reinkemeyer has been assigned as production engineer for Sohio Petroleum Co. in Russell, Kans He was formerly engineering trainee.

J. D. Aldridge has been promoted by Sinclair Oil & Gas Co. from chief engineer at Sinclair's St. Louis, Okla., gas products plant to assistant construction superintendent in Seminole, Okla.

Charles M. Cole, Jr., Tuloma Gas Products Co.'s senior mechanical engineer, has been promoted to chief engineer. Cole was with Pan American Petroleum Corp. before he joined Tuloma in 1954.

Phil H. Dau, chief engineer with Dutton-Williams Brothers, Ltd., has been named manager of operations. **Mark A. Hardie,** formerly with Pacific Northwest Pipeline Corp., will succeed Dau as chief engineer.

A. V. Robertson Coe has been appointed acting district geologist for Husky Oil Co.'s Cody, Wyo., district. Coe has been with Husky since 1948 but has been on leave of absence for the past 21 months. **Raymond E. Maret** will be assistant district geologist at Cody. Maret joined Husky in 1956.

H. S. Brigham has resigned as zone manager of production for Gulf Oil Corp. at Laurel, Miss., to join Dixilyn Drilling Corp., Fort Worth, as executive vice president. Brigham was California division manager for Western Gulf Oil Co., subsidiary of Gulf, before transferring to Mississippi in 1955. He was Gulf's San Joaquin Valley district superintendent before that time.

J. R. Hurley has been transferred by Shell Oil Co. from New York, where he was supplies manager of the transportation and supplies department, to Calgary, where he will be crude-oil representative in exploration and production. In Calgary he succeeds **R. L. Hope,** who has been transferred to New York to take over Hurley's former position as supplies manager.

R. A. Bautts, manager of operations for MidSouth Gas Co., has been elected a vice president.

Gordon Cole, Los Angeles consulting geologist, has moved his offices to Bakersfield, Calif.

E. D. Klinger, chief geologist of Lion Oil Co., has retired. He will open consulting offices in Shreveport. Klinger had been with Lion since 1936.

Fred E. Woodring has resigned as executive vice president of the Rocky Mountain Oil and Gas Association.

Karel H. Beekhuis has been named president of Aramco Overseas Co., Arabian American Oil Co.'s subsidiary which provides engineering, purchasing, and other services for the parent company. Beekhuis formerly was executive vice president of Amoseas. His headquarters will be in The Hague.

A. H. Wadsworth, Jr., geological consultant, has moved his offices to Houston from Bay City, Tex.

A. G. (Sam) Ford, Northern Illinois Gas Co.'s assistant manager of operation, has retired.

Jerry A. James has been promoted by Gulf Oil Corp. from trainee to production engineer and transferred to Lafayette, La., from Cut Off, La.

A. G. Hardison, district geologist in Amarillo, Tex., for Kerr-McGee Oil Industries, Inc., has been elected president of the Panhandle Geological Society succeeding **W. H. Fitzgerald** of Continental Oil Co. Other officers are **Harold Henslee,** Phillips Petroleum Co., vice president; **Dan Kozak,** Pure Oil Co., secretary; and **E. D. Anthony,** Sun Oil Co., treasurer.

Max F. Powell has joined **Russell Maguire,** Dallas oil producer, as chief engineer in charge of operations in Texas, Oklahoma, Kansas, Louisiana, Mississippi, and New Mexico. Powell has been a consultant in Austin, Tex., the past year. Before that time he was reservoir engineer with **Joe Ballanfonte,** Austin consultant. He was a senior engineer with The Texas Railroad Commission from 1951 to 1953.

Personals

J. E. SELDEN

John E. Selden, executive vice president of South Penn Oil Co., has been elected president. He succeeds **George J. Hanks,** who has been named chairman of the executive committee. **Charles L. Suhr** will continue as chairman of the board. Selden has been with South Penn since 1930. He became assistant secretary of the company in 1930, a director in 1934, vice president and counsel in 1946, and executive vice president earlier this year. Hanks was a vice president of Tidewater Oil Co. before joining South Penn in 1944. He was elected president of the company soon after joining it and became chairman of the board in 1953. After the merger of Pennzoil and South Penn in 1955, Hanks was again elected president.

M. J. Huffman, assistant manager of crude-oil purchasing for Imperial Oil, Ltd., has been named manager of the Calgary crude-oil purchasing office. He succeeds **J. Warren Flanagan,** who has been moved to Toronto as assistant manager of the coordination and economics department.

Richard S. Hicklin, exploration manager of Carter Oil Co.'s central division, Oklahoma City, has been appointed western division exploration manager. He will transfer to Denver August 1. He replaces **John L. Cook,** who has been transferred to Billings, Mont., as exploration manager of the northern region.

R. O. Rhoades has been elected a member of the board and of the executive committee of Gulf Oil Corp. He will continue as senior vice president and chairman of Gulf's administrative committee. In past years he has been chief staff geologist and chief of the company's land and exploration branch of the production department.

Robert B. Baum, assistant vice president of Seismograph Service Corp., will head the company's new southern division office in Houston. Division headquarters were recently transferred to Houston from Tulsa. **E. B. Lindsey** has been named technical supervisor in Houston. Lindsey has been abroad for 10 years as geophysical supervisor for Seismograph Service and its foreign subsidiaries.

Harry Jacobs, who retired last year from Shell Oil Co., has joined Hess Petroleum Corp. in New York as vice president.

William W. Stevens, Jr., formerly with Magnolia Oil Co. in Wichita, has joined Franco-Central Oil Co. as senior geologist.

Chadwick H. Carpenter has been named to the new post of executive assistant to the president of Standard Oil Co. (N. J.). He formerly was secretary of the executive committee and assistant secretary.

Henry H. Neel has been appointed manager of foreign exploration for Tidewater Oil Co. Neel has been western division exploration manager for Tidewater since 1955. He will continue to headquarter in San Francisco.

Harry M. Schafer has been appointed manager of supply for Union Oil Co. He will be in charge of crude oil and products purchases. Schafer was formerly manager of distribution in Union's southwest marketing area.

L. M. Harris has been transferred by Humble Oil & Refining Co. from Los Angeles, where he was senior petroleum engineer, to the company's Castaic Junction, California, district as district petroleum engineer.

C. M. Bailey has been appointed district superintendent for Shell Oil Co. in Billings, Mont.

J. A. Martin has been transferred by Clinch Drilling Co. to Buras, La., from New Iberia, La., as drilling superintendent.

J. C. Bauguss, Jr., has been appointed valuation engineer for Southern Pacific Pipe Lines, Inc. He will headquarter in Los Angeles.

H. C. Wynne, Oklahoma City independent; **James D. Kersey,** chief geologist of Seneca Oil Co.; and **Ernest W. Veigel,** president of Rochester Business Institute, Rochester, N. Y., have been elected directors of Seneca Oil Co.

Charles F. Barnard, formerly chief engineer, Minnesota Pipe Line Co., St. Paul, Minn., has been named assistant chief engineer of Pipe Line Engineering Co., Dallas.

H. F. Tomfohrde, Jr., has been named manager of the transportation and supply department in Tidewater Oil Co.'s eastern division. Tomfohrde has been manager of the division's lubricants supply department for the past year. **Leonard W. Doolan, Jr.,** supervisor of process section of lubricants supply, will succeed Tomfohrde as manager of the department.

DEATHS

Dr. Vasili I. Komarewsky, 62, professor of engineering at Illinois Institute of Technology, died June 21. Komarewsky was one of a group of scientists who developed many modern petroleum processes including polymerization, alkylation, and isomerization. Komarewsky was noted for his work on the discovery of vanadium-oxide catalysts and hydrogenation and hydrodesulfurization reactions. He was the coauthor of several books on petroleum processing including "Isomerization of Pure Hydrocarbons," and "Techniques of Catalytic Reactions."

Frank A. Elliott, 72, pioneer oil driller and producer, died June 20 in Tulsa. Elliott entered the oil business in Ohio in 1902 with the old Cameron & Sons. He later worked in Ohio, Indiana, Illinois, California, and Oklahoma. In 1911 he formed Elliott Brothers Drilling Co. in Tulsa with his brother, the late W. C. Elliott.

James Emmett, Jr., 50, vice president of James P. Marsh Corp., died recently in Hinsdale, Ill., after a heart attack.

Dudley Kent Bowen, 59, manager of Mountain Fuel Supply Co.'s producing division, died recently in Rock Springs, Wyo. Bowen had been active in the Rocky Mountain area with Mountain Fuel and its predecessors since 1918.

Eugene F. Bangs, 40, development engineer with Aero Service Corp., died June 22 in Philadelphia of bronchial pneumonia. Bangs was one of the developers of the airborne magnetometer used in oil exploration.

John Byrne, retired partner in the old Byrne & Cutler Drilling Co., now Cutler Drilling Co., died June 21 in Tulsa. Byrne, 88, retired in 1947.

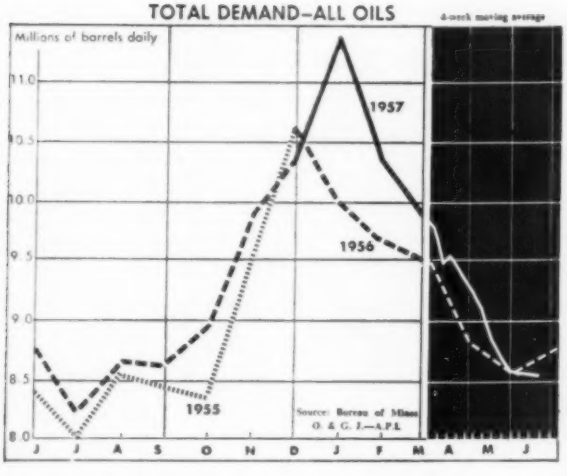
C. F. Hissam, 46, Odessa, Tex., tool pusher for Keating Drilling Co., Tulsa, died recently after a heart attack. Hissam had been with Keating in the West Texas area since 1951.

Lester G. Housh, partner in Housh Drilling Co., died June 21 in a Houston hospital.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,273,725	DOWN	32,325	UP	151,208
Crude stocks	274,227,000	UP	5,776,000	UP	152,000
Completions	1,035	UP	57	DOWN	188
Refinery runs	7,859,000	UP	132,000	DOWN	228,000
Gasoline stocks	189,225,000	DOWN	2,092,000	UP	8,121,000
Kerosine stocks	27,975,000	UP	1,188,000	UP	3,392,000
Distillate stocks	110,282,000	UP	4,111,000	UP	22,489,000
Residual stocks	43,885,000	UP	1,015,000	UP	5,835,000
Four-product stocks	371,367,000	UP	4,222,000	UP	39,837,000
Total imports	1,352,800	DOWN	373,400	DOWN	298,400



Big Stock Increase Seen for July . . . Could be Crude—or Products

THE PROBLEM of rising inventories has not been solved for July. Part of the problem can be charged to past operations. It may take several months of severe adjustments to get back on the track.

Here is the crude picture for July. The Texas Railroad Commission cut allowables a little more than 400,000 bbl. daily. Part of this reduction will be regained from output of new wells that are completed during the month. Another reduction was announced for Louisiana, about 15,000 bbl. daily. The net reduction from these cuts will be about 365,000 bbl. daily.

Crude production for June averaged about 7,300,000 bbl. daily. About 65,000 bbl. daily of this was due either to pipeline proration by companies with refineries closed by strikes, or to weather.

If the refineries are back on stream in July, total crude production will average about 7,000,000 bbl. daily. This compares favorably with the Bureau of Mines' forecast of demand for domestic crude. The bureau's estimate was 6,975,000 bbl. daily.

To arrive at its estimate, the bureau estimated crude imports for July at 1,050,000 bbl. daily. This average may be too low. Company reports to the Texas Railroad Commission listed 1,216,000 bbl. daily of foreign crude to be imported in July. The total will be higher because some importing companies do not report to the commission. This unreported portion has averaged better than 50,000 bbl. daily for most months.

If importers bring in crude at the planned rate and the nonreporting portion averages 50,000 bbl. daily, total crude imports for July will be at least 1,266,000 bbl. daily.

Crude imports plus domestic crude production will average about 8,266,000 bbl. daily. Crude exports will be back to normal in July. Crude losses, transfers, and exports will total about 90,000 bbl. daily. The remaining 8,176,000 bbl. daily will be processed at refineries or will go to storage.

Crude inventories amounted to 274,227,000 bbl. on June 15. More was added during the last 2 weeks of June. This means that July starts with excessive crude stocks. Will refiners run all of the 8,176,000 bbl. that will be available daily in July?

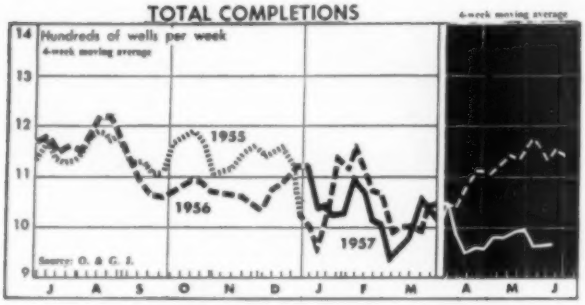
That's more than refiners have ever run in July. In fact, runs have been that high only one time in the past. That was in January of this year when total demand topped 11,000,000 bbl. daily for the first time.

Refinery runs of 7,700,000 bbl. daily in July would help clear up the products market but should be held down at least to 7,800,000 bbl. daily. If runs average 7,800,000 bbl. daily, the outlook is for another increase in crude stocks of 11,000,000 bbl. in July.

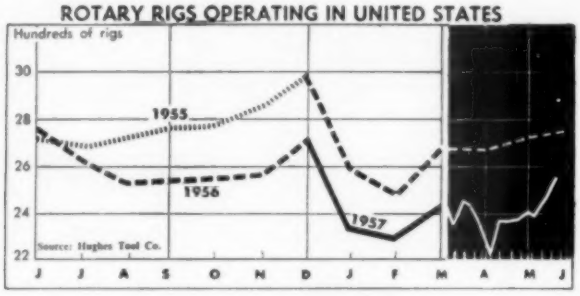
Product spot markets have changed very little in the past week. Annoucements of tank-wagon increases of about 0.2 cent a gallon by several large marketers have given the over-all market a better tone but haven't changed spot prices.

Reports from the Gulf Coast indicate some shading of heavy fuel prices in that area. Some low-sulfur residual is available in the Mid-Continent area. Refiners with plants closed by strikes have used up much of the surplus gasoline that was in Mississippi River terminals.

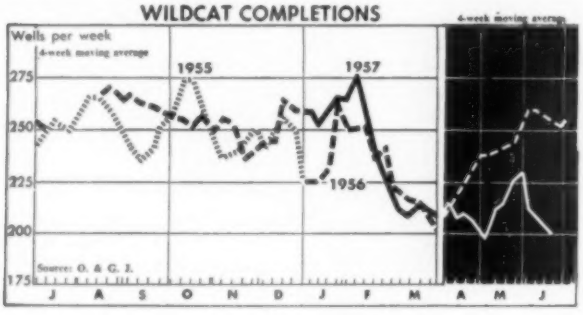
TOTAL COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



WILDCAT COMPLETIONS



ACTIVE ROTARY RIGS*

Area—	6-24-57	6-17-57	6-25-56
North Central and East	100	97	130
Southeast	52	51	30
Okla., Kans., Ark., Mo.	422	409	506
Louisiana	435	436	448
North and East Texas-Panhandle	439	392	426
Gulf and South Texas	216	199	272
West Texas-New Mexico	543	543	545
Rocky Mountain	249	250	262
Pacific Coast	108	106	123
Total United States	2,564	2,483	2,742
Canada	222	216	252

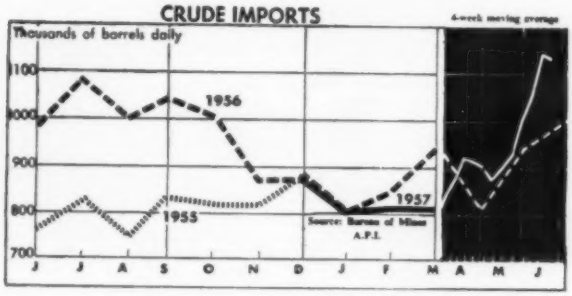
*Hughes Tool Co.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED JUNE 22, 1957

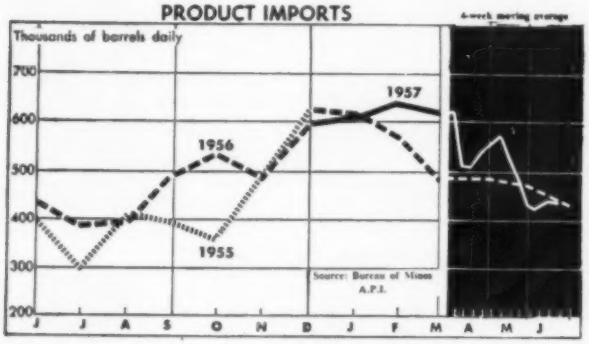
	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1957				
	Comp.	Oil	Gas	Dry	Footage	1957	1956	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.	†1	1	0	0	11,512	55	49	0	0	0	0	0	0	0	1	19	20
Arkansas	14	6	1	7	56,068	454	375	1	0	1	3	5	12	0	4	63	79
California	49	35	2	12	230,927	1,054	1,066	0	0	1	10	11	27	0	5	224	256
Colorado	15	4	0	11	74,151	402	560	0	0	0	11	11	13	0	9	248	270
Illinois	43	16	0	27	106,681	1,139	1,698	1	0	0	8	9	13	0	1	267	281
Indiana	10	5	0	5	22,145	298	293	0	0	0	0	0	5	0	0	53	58
Kansas	85	21	12	52	313,596	1,963	2,438	2	0	1	16	19	52	0	13	322	387
Kentucky	30	12	0	18	30,952	645	789	0	0	0	9	9	13	0	4	107	124
Louisiana	83	35	12	36	599,368	1,782	1,880	1	0	2	12	15	38	9	48	224	319
North	34	15	6	13	107,714	596	762	1	0	0	5	6	7	0	5	64	76
South	31	10	4	17	331,917	840	894	0	0	2	6	8	22	8	36	135	201
Offshore	18	10	2	6	159,737	346	224	0	0	0	1	1	9	1	7	25	42
Michigan	5	1	0	4	10,418	183	218	0	0	0	3	3	7	0	0	69	76
Mississippi	8	2	0	6	53,290	171	211	0	0	0	5	5	10	1	0	76	87
Montana	16	8	0	8	73,987	168	167	0	0	0	7	7	5	0	0	55	60
Nebraska	14	4	0	10	82,656	373	499	0	0	0	8	8	19	0	1	190	210
New Mexico	52	31	14	7	278,848	969	881	0	0	0	2	2	33	1	7	91	132
Northwest	21	6	14	1	104,713	364	333	0	0	0	0	0	14	1	5	28	48
Southeast	31	25	0	6	174,135	605	548	0	0	0	2	2	19	0	2	63	84
New York	9	4	0	5	9,250	222	....	0	0	0	0	0	0	0	1	0	1
North Dakota	3	2	0	1	22,842	133	116	0	0	0	1	1	6	0	0	47	53
Ohio	37	20	4	‡13	93,550	503	493	0	0	0	0	0	0	0	0	3	3
Oklahoma	113	62	5	‡46	394,612	2,978	4,197	0	0	0	12	12	47	9	8	275	339
Pennsylvania	0	0	0	0	0	354	*434	0	0	0	0	0	0	0	15	20	35
Texas	410	237	16	157	1,812,489	10,328	10,524	11	0	0	83	94	311	39	96	2,173	2,619
Southwest (1 & 4)	52	22	1	29	204,407	1,283	1,550	0	0	0	17	17	39	14	27	370	450
Gulf Coast (2 & 3)	68	34	2	32	483,891	1,214	1,292	1	0	0	13	14	24	17	44	315	400
East (5 & 6)	25	12	0	13	124,577	591	536	2	0	0	8	10	6	2	2	171	181
North Central (7-B & 9)	118	55	6	57	343,000	3,657	3,796	3	0	0	28	31	163	0	13	926	1,102
West (7-C & 8)	121	99	0	22	549,188	2,941	2,737	4	0	0	14	18	72	0	8	359	439
Panhandle (10)	26	15	7	4	107,426	642	613	1	0	0	3	4	7	6	2	32	47
Utah	7	3	0	4	39,176	82	41	0	0	0	2	2	6	0	3	37	46
West Virginia	16	5	9	2	37,741	296	318	0	0	1	0	1	0	0	9	4	13
Wyoming	15	2	2	11	66,268	381	363	0	0	0	7	7	13	0	3	111	127
Miscellaneous	0	0	0	0	0	32	58	0	0	0	0	0	0	0	1	24	25
Total United States	**1,035**	516	77	442	4,420,527	24,965	27,668	16	0	6	199	**221**	630	59	229	4,702	5,620
Total previous week	978	561	77	340	4,249,996	....	....	37	4	10	152	203	614	59	223	4,503	5,399
Total June 23, 1956	1,223	714	74	435	4,915,410	....	....	24	3	7	207	241	739	69	191	5,035	6,034
Cumulative, 1957	24,965	13,371	1,814	9,780	104,126,844	....	....	....	....	....	....	....	....	....	....	....	....
Western Canada	37	28	2	9	156,182	1,239	1,154	1	0	0	8	9	32	0	25	274	331

*Incl. N. Y. †Ala. Service wells included ‡3.

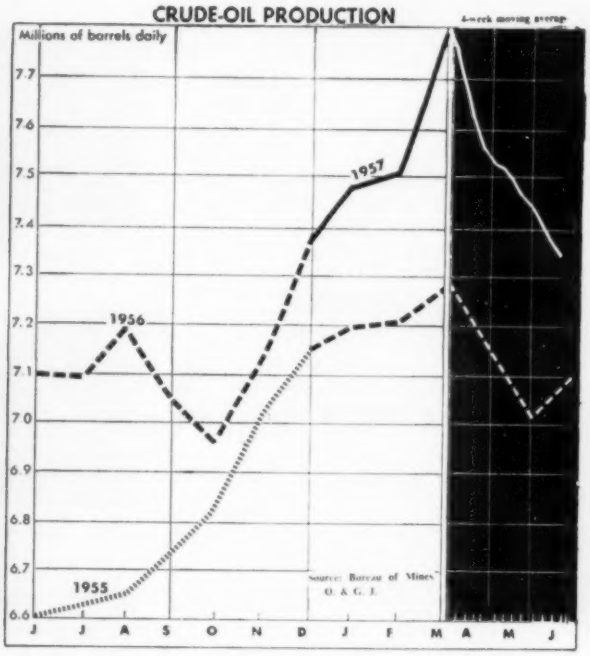
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION

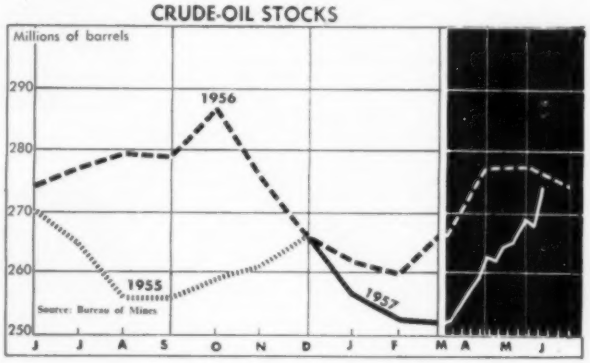


DAILY AVERAGE PRODUCTION FOR WEEK

	June 22, 1957			June 15
	Crude oil	Lease condensate	Total	total
Alabama	12,400		12,400	12,100
Arkansas	86,400	350	86,750	85,850
California	927,900		927,900	926,600
Colorado	150,900		150,900	152,550
Eastern	51,700		51,700	51,300
Florida	1,275		1,275	1,275
Illinois	163,300		163,300	207,500
Indiana	27,400		27,400	30,400
Kansas	†354,400		†354,400	†347,900
Kentucky	39,700		39,700	43,600
Louisiana	807,500	75,600	883,100	881,600
North	132,500	3,100	135,600	134,100
South	675,000	72,500	747,500	747,500
Michigan	28,700		28,700	27,300
Mississippi	110,600	4,500	115,100	115,100
Montana	74,350		74,350	73,850
Nebraska	52,150		52,150	52,225
Nevada	100		100	100
New Mexico	258,500	4,500	263,000	262,100
North Dakota	38,200		38,200	35,100
Oklahoma	†591,800		†591,800	†580,500
Texas	3,051,500	53,500	3,105,000	3,105,000
Dist. 1	53,500	450	53,950	53,950
Dist. 2	144,000	8,350	152,350	152,350
Dist. 3	435,000	26,200	461,200	461,200
Dist. 4	229,000	6,100	235,100	235,100
Dist. 5	40,000	300	40,300	40,300
Dist. 6	135,000	6,400	141,400	141,400
East Texas field	200,000		200,000	200,000
Dist. 7-B	167,000	75	167,075	167,075
Dist. 7-C	163,000	3,600	166,600	166,600
Dist. 8	1,170,000	1,100	1,171,100	1,171,100
Dist. 9	213,000	600	213,600	213,600
Dist. 10	102,000	325	102,325	102,325
Utah	7,700		7,700	9,550
Wyoming	298,700		298,700	304,450
Others	100		100	‡100
Total U. S.	7,135,275	138,450	**7,273,725**	7,306,050
Change from prev. week, down			**32,325**	
Canada	†552,000		†552,000	†527,900
Total U. S. production, January 1-June 22			1,306,629,000 bbl.	
Same period last year (crude plus cond.)			*1,247,299,006 bbl.	

*Includes 22,049,380 bbl. condensate. †Week ended previous Monday. ‡South Dakota.

CRUDE-OIL STOCKS



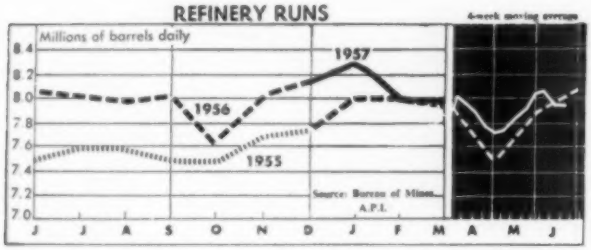
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

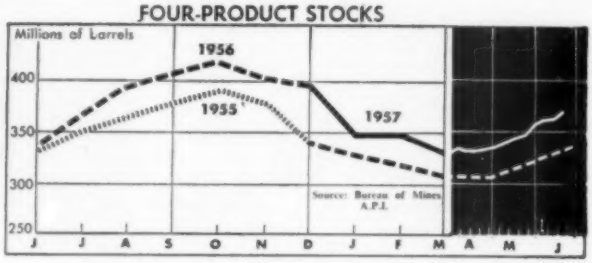
	6-15-57	6-8-57	6-16-56
Pennsylvania Grade	2,718	2,673	2,606
Other Appalachian	1,871	1,898	2,255
Illinois, Indiana, Michigan	9,483	9,622	10,760
Nebraska, North Dakota	2,416	2,082	2,634
Kansas	11,292	10,863	9,193
Oklahoma	20,995	21,292	27,294
Arkansas	2,861	2,932	3,098
Louisiana	18,392	18,396	15,570
North	2,818	2,846	2,558
South	15,574	15,550	13,012
Mississippi	2,566	2,614	3,054
New Mexico	7,941	8,166	7,349
Texas	127,829	124,295	124,042
East Texas proper	11,475	11,548	9,172
West Texas	61,342	59,199	60,362
Texas Gulf	24,312	23,584	21,859
Other Texas	30,700	29,964	32,649
Wyoming	16,798	16,484	18,216
Other Rocky Mountain	5,914	5,787	6,169
California	27,257	26,994	27,511
Foreign	†15,894	14,353	14,324
Total	274,227	268,451	274,075

*Bureau of Mines. †Includes 3,746,000 bbl. in California.

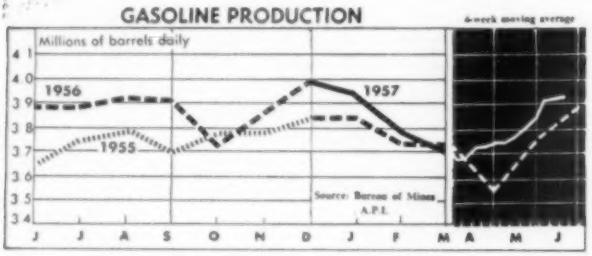
REFINERY RUNS



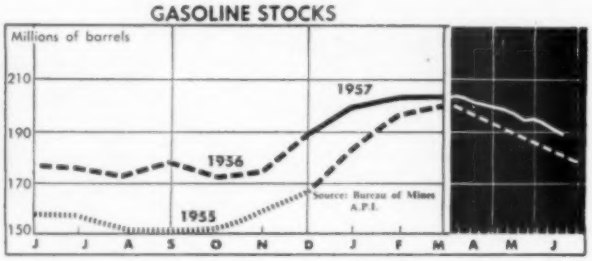
FOUR-PRODUCT STOCKS



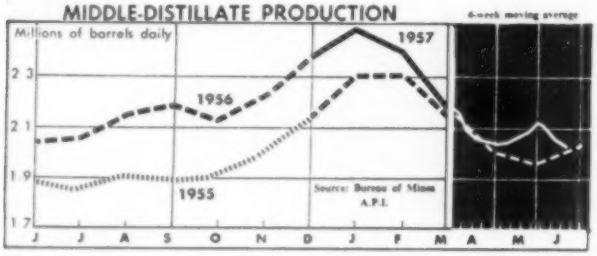
GASOLINE PRODUCTION



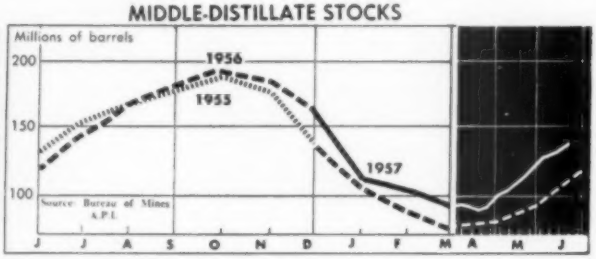
GASOLINE STOCKS



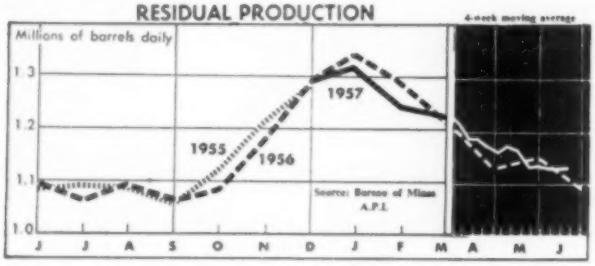
MIDDLE-DISTILLATE PRODUCTION



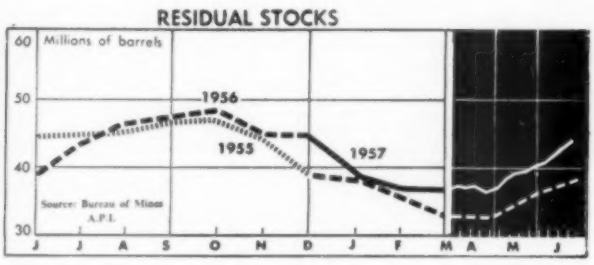
MIDDLE-DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



A.P.I. REFINERY REPORT, JUNE 21, 1957

(Thousands of barrels)

District—	Daily avg. runs	Daily average production— Gaso.*	Kero.	Dist.	Resid.	Stocks‡ Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, June 1956 Daily avg. runs	Daily average production— Gaso.*	Kero.	Dist.	Resid.
East Coast	1,163	478.2	30.6	266.6	203.4	42,807	11,195	37,347	10,485	1,149	440.0	35.3	290.5	193.1
Appalachian:														
District 1	95	42.1	3.0	20.0	4.1	4,761	569	2,211	462	109	43.8	2.6	27.8	5.0
District 2	48	29.4	2.0	6.9	7.0	2,591	507	827	334	95	53.4	4.8	13.8	12.7
Ind., Ill., Ky.	1,318	677.9	54.1	259.3	162.9	33,176	5,213	16,954	5,882	1,359	688.0	71.4	251.8	146.6
Minn., Wis., Dak.	96	46.9	8.9	22.1	12.1	6,490	850	4,894	392	93	45.6	7.7	25.2	6.9
Okla., Kans., Mo.	735	406.4	12.7	161.1	30.6	17,230	1,392	9,800	972	717	399.8	14.3	169.1	30.1
Inland Texas	274	200.7	14.9	46.7	18.1	7,526	407	2,197	1,776	280	207.5	6.4	51.3	22.2
Texas Gulf Coast	1,881	942.3	76.1	417.4	236.2	24,558	3,319	12,948	6,026	2,040	971.5	94.1	510.7	262.9
La. Gulf Coast	680	382.4	54.6	176.9	57.4	10,889	3,173	6,218	1,460	740	373.5	38.3	182.4	49.0
N. La. and Ark.	88	35.1	5.0	20.4	5.9	4,478	726	2,024	48	99	36.1	6.7	25.1	6.4
Rocky Mountain:														
New Mexico	28	14.6	0.7	6.0	3.9	281	12	77	70	23	12.1	0.2	4.4	3.4
Other Rocky Mtn.	300	138.2	3.1	68.7	38.3	7,244	248	2,867	1,164	286	135.2	4.1	63.3	33.1
California	1,153	507.7	5.0	206.6	322.4	27,194	364	11,918	14,814	1,081	473.2	4.2	139.3	327.0
June 21, 1957	7,859	3,901.9	270.7	1,678.7	1,102.3	189,225	27,975	110,282	43,885	8,071	3,879.7	290.1	1,754.7	1,098.4
June 14, 1957	7,727	3,893.4	246.0	1,692.3	1,092.1	191,317	26,787	106,171	42,870	.....	.....	.....	.....	.....
June 22, 1956	8,087	3,894.7	279.1	1,783.9	1,099.4	181,104	24,583	87,793	38,050	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (89 octane)	11.50-12.00
Premium (98 octane)	14.25-14.75
Gulf Coast (cargoes for coastwise or export movements):	
*Regular (90 octane)	10.75-11.25
*Regular (92 octane)	11.00-11.50
*Premium (97 octane)	12.75-13.25
*Premium (98 octane)	13.00-13.50
*Effective June 19.	
California (rack):	
Regular (88 octane)	13.1
★ Premium (96 octane)	15.1
★ Premium (98 octane)	15.2
Caribbean area (cargoes):	
Regular (87 octane)	10.875
Premium (93 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
Grade 26-70	4.0
Breckenridge:	
Grade 26-70	3.5

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16 lb. Prices for grades below 16 lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	9.75-10.25
Diesel oil (58 d.i. and above)	9.375-9.75
Distillate No. 1	9.375-9.75
Distillate No. 2	8.75-9.125
Gulf Coast (cargoes):	
★ Kerosine 41-43	9.375-9.75
★ Distillate No. 2	9.25-9.50
New York Harbor (barges):	
★ Kerosine 41-43	11.55
★ Distillate No. 2	11.05
★ Diesel fuel, 48-52 d.i.	11.35
Caribbean area (cargoes):	
Distillate No. 2	9.5

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude scale (solid in bags or barrels)	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
★ Residual fuel (max. 1% S)	$2.10-2.25
Gulf Coast (cargoes):	
★ Bunker C fuel	$2.65-3.00
New York Harbor (barges):	
Bunker C fuel	$3.10
Caribbean (cargoes):	
Bunker C	$2.55
California (rack):	
Bunker C fuel, Los Angeles	$2.85-3.00

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., v.i.	25.5
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	22.25
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	28
200 vis. neutral (180 at 100°), 25 p.t.	26

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour)
14-14.9	$2.67				
15-15.9	2.71				$1.89
16-16.9	2.74				1.94
17-17.9	2.78				1.99
18-18.9	2.82				2.04
19-19.9	2.85				2.09
20-20.9	2.89	$2.75		$2.62	2.14
21-21.9	2.93	2.77		2.64	2.19
22-22.9	2.97	2.79		2.66	2.24
23-33.9	3.01	2.81	$3.44	2.68	2.29
24-24.9	3.05	2.83	3.46	2.70	2.34
25-25.9	3.09	2.85	3.48	2.72	2.39
26-26.9	3.13	2.87	3.50	2.74	2.44
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95		2.82	2.63
31-31.9	3.38	2.97		2.84	2.67
32-32.9	3.44	2.99		2.86	2.71
33-33.9	3.50	3.01		2.88	2.75
34-34.9	3.56	3.03		2.90	2.79
35-35.9	3.61	3.05		2.92	2.83
36-36.9	3.65	3.07		2.94	2.87
37-37.9	3.68	3.09		2.96	2.89
38-38.9		3.11		2.98	2.91
39-39.9		3.13		3.00	2.93
40 and up		3.15		3.02	2.95

*Includes Oklahoma, part of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low Cold test Gulf Coast. ‡Sour.

Effective dates: California January 17, 1957, east of California, January 3-January 10, 1957; Pennsylvania Grade, January 16, 1957.

Some crudes in North Central Texas and West Central Texas, are on the intermediate schedules.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.88
Middle District	4.70
Southwest Pennsylvania	4.41
West Virginia	4.23
Buckeye Grade	4.23
Zanesville Grade	3.27
Illinois Basin	**3.15**
Canada:	
Leduc-Woodbend	2.78
Redwater (Alta.)	2.67
Smiley (Sask.)	2.44
Pembina	2.65

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 40°-40.9°, Puerto La Cruz	3.37
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
Quiriquire, 16.5°-16.9°, Caripito	2.45
Lagunillas heavy, flat, Amuay or Las Piedras*	2.38
Bachaquero, flat, Las Piedras*	2.23

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
★ Arabian, 36.0°-36.9°, Ras Tanura	$2.12
Iranian, 34.0°-34.9°, Bandar Masur	2.04
Iranian, 34.0°-34.9°, Abadan	1.99
Iraq, 36.0°-36.9°, Fao	2.00
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.85
Qatar, 39.0°-39.9°, Umm Said	2.19
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.69
Iraq, 36.0°-36.9°, Tripoli, Banias	2.69
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°	2.75

TANKER RATES PER LONG TON

(Latest reported spot fixtures)

Gulf-N.S.N.H., clean (USMC—20%)	$2.28
★ Carib.-U.S.N.H., dirty (USMC—35%)	1.76
★ Carib.-U.K., dirty (Scale—16.5%) (27s. 2d.)	3.80
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★ P.G.-Cont., dirty (Scale—17.5%) (44s. 7d.)	6.24

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CAN DELIVER 1,000 to 5,000 bbls. crude oil daily, low grade or regular in tank cars or in pipe line at Wyoming points. Producer, P. O. Box 2362, Denver, Colorado.

PRODUCTION WANTED

WANTED: Oil or gas production, any size, prefer, Okla., N. M., Tex., Colo. or Kan. B Thurston, 1427 Princeton NE, Albuquerque, N. M.

WANT TO BUY—Oil Properties, settled or semi-settled production. 100 to 5,000 barrels daily in Oklahoma and Kansas. Contact Morris Sitrin, 1215 First National Building, Tulsa, Oklahoma.

PRODUCING oil, gas properties, also royalties wanted. Any size, any amount. Complete details in first letter. Box 231, Scarsdale, N. Y.

MAP CABINETS

END MAP-FILING WORRIES FOREVER! Kraftbilt Rollfiles keep rolled maps safe from dust, dampness, pilferers. Used by all major and hundreds of smaller oil companies. Send for new Catalog 1156-B, Ross-Martin Co., P. O. Box 800-A, Tulsa 1, Okla.

BUSINESS OPPORTUNITIES

FINANCIAL CONTACTS. Underwriters, Brokers, Private Finders of Capital reached. No shopping. Confidential. FREE ENTERPRISE ASSOCIATES, 817 51st St., Brooklyn, N. Y.

FUNDS AVAILABLE to drill 100 wells on proven acreage only. Detailed offers invited. Box 613, Fort Worth, Texas.

PATENTED MINES FOR SALE. We own twenty-five patented mining claims in Crystal Area, Rock Creek Mining District, Gunnison County, Colorado. Due to my advanced age advisable to dispose of them. Sale or bonded lease to responsible parties, either entirely or in block. PROVEN high grade lead and zinc, some copper, pitchblend present . . . may have commercial uranium. FOR DETAILS address Vernon J. Rose, 2803 Benton Boulevard, Kansas City, Missouri.

Well organized, well established oilwell drilling contractor desires the management and supervision of oil properties in West Texas, Central Texas, and New Mexico. Can provide complete handling of oil properties from acquisition to production. No properties too small, none too large to handle. Inquiries from independents, groups, small or medium sized oil companies invited. Write, wire or call collect for further information.

MAKIN DRILLING COMPANY
P. O. Box 1628
Hobbs, New Mexico
Phone: EXpress 3-3141

FOR SALE EQUIPMENT

FOR SALE at El Dorado, Kansas, attention: C. W. Schwenker, 2—Imperial type 10 XRB Ingersoll-Rand horizontal belt driven vacuum compressors with 14" x 10" cylinders each $850.00. Take both $1500.00. Cities Service Oil—Patridge—Bartlesville.

FOR SALE: Gas Test Equipment. One 1951 Model Chevrolet Panel Truck complete with Onan drive compressor equipment and Ranarex specific gravity indicator. Contact The Superior Oil Company, Chickasha, Oklahoma, Yard, telephone 3303.

STEEL PIPE & TUBING
• MONEL • CARBON STEEL • STAINLESS
• CHROME MOLY • CARBON MOLY
Widest Range of Sizes & Specs in the U. S.
WRITE FOR STOCK LIST
MIDCONTINENT TUBE SERVICE, INC.
2308 Oakton St., Evanston, Ill. DA 8-4030

FOR SALE EQUIPMENT

7000 FT. 3½ I.F. modified drill pipe; 4¾ tool joints; elevators; rotary slips; and six (6) 5¾ drill collars. Box 297, Tyler, Texas.

FOR SALE
ROTARY DRILLING RIGS
EXCELLENT CONDITION
Model S Cardwell—2000' to 4000' Drilling
Model E Cardwell—3000' to 6000' Drilling
Model O Cardwell—4000' to 8500' Drilling
Model U15 Unit Rig—4000' to 8500' Drilling
All equipped with Lee C. Moore Mast and substructure. Rigs complete in every detail.
CABLE TOOLS
Model RL Cardwell 3 Drum Double Mast
Model 66 Wichita Spudder
PRICED FOR IMMEDIATE SALE
Robinson Drilling Company
P. O. Box 153 Phone ORchard 4-6622
Abilene, Texas

BRILL BUYS—THE BEST!

NEAR LONGVIEW, TEXAS

FORMER LACY REFINERY

1—Wyatt 30" x 70" Stabilizer 160# 30 tray
1—5' x 96' tower, 40 tray, 135# WP.
1—2' x 50' tower, 24 trays.
1—Ethyl lead plant.
2—Upshot heaters, 10 mil. BTU/hr.
8—Welded storage tanks, 5,000, 2,000 bbl.
8—Hi-vol pumps, 10 x 7 x 18, 10 x 6 x 12, 6 x 4 x 12, 6 x 3 x 8.

IN STOCK

VESSELS

2—12' x 45' Storage Tanks, 25#
1—14' x 21' Clay Tower, 125#
1—8' x 75' Tower, 20 Trays, 25#
1—18" x 32' Tower, 15 Trays, 160#
2—8½' x 25' Tanks, 50#
5—Packed Towers 14" x 40', 18" x 23', 160# Wyatt 1950.
1—Poly Reactor, 550#, 24" x 28'.

HOT-OIL PUMPS

3 Pacific ITB, 400 gpm.—2,000' hd. 735 gpm—3,100' hd.
5 Pacific 5VTB, 612 gpm—600' hd. 324 gpm—480' hd, 308 gpm—516' hd, 193 gpm—389' hd.
1 Pacific HVTB (unused) 1270 GPM—408' Hd.
BJ hot oil pump 3 x 9, 13 st, 325 gpm, 4600' hd.

HEAT EXCHANGERS

4—Kellogg Adm. Fltg. Hd. 2200, 1300 Sq. Ft., 315#
4—Kellogg Steel Flg. Hed. 800, 650, 500 Sq. Ft.
18—GR Fin Tubes, 73 Sq. Ft.
6—Brown fintube exchangers, 300# 140 Sq. Ft. 4-6 chrome
5—Steel 1,000, 900, 800, 600, 500 Sq. Ft.
6—Adm. 785, 742, 425 Sq. Ft.
30—304 SS shell & tube condensers 100-1000 Sq. Ft.

COMPRESSORS

1 Worth LTC-6 800 hp.
3 Penn Comps 100 CFM 500 lbs.
385 CFM 160 lbs.

MISCELLANEOUS

6—Bird Centrifugals 32 x 50, 24 x 38, 18 x 28.
5—Sweetland Filters No. 12, No. 10, No. 7, No. 5.
4—Rotary Vac. Filters, 10 x 12, 8 x 10, 5 x 8.
Lab Petro-Chem furnace 50,000 BTU/hr.
Tremendous selection stainless steel and steel valves 1½"-6".
Goulds 16" pump, 10,500 gpm, 135' hd.

We Own The Equipment We Advertise.

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BRILL EQUIPMENT COMPANY

4101 San Jacinto St., Houston 4, Texas, JA 6-1351
or
2401 Third Ave., New York 51, N. Y., CYpress 2-5703

FOR SALE EQUIPMENT

FOR SALE at Drumright and Cromwell, Oklahoma, approximately 15,000' 6" 18.97# used PE LW Beveled Line Pipe, Range One, price $1.25 per foot. Cherokee Pipe Line—Patridge—Bartlesville.

MODEL U-15 UNIT RIG complete with L. C. Moore double jackknife derrick, 3508' new and 3200' used 4½" drill pipe, 19 drill collars. Rig and motors in A-1 condition. W. D. Kelley Drilling Co., 409 Combs-Worley Bldg., Pampa, Texas.

FOR SALE Cheap. K. L. Cardwell Spudder, lines mast and tools complete. Vergil Turner, 621 North Murphy St., El Dorado, Ark.

FOR SALE—Cardwell Spudder. In good condition, both looks and operation. Complete with all tools. Priced right. K & A Drilling Co., Phone 448R, Box 497, Ellinwood, Kansas.

C-34 WALKER-NEER Spudder, with or without 5-7 tools. A-1 condition. Fully equipped. Located at Drumright, Oklahoma Box 788 or phone 20, Drumright.

SALES AND RENTALS. Used cable drilling and fishing tools, casing, production equipment, from the Southwest's largest stock of oil field supplies. Degen Pipe and Supply Co., Tulsa.

FOR SALE: Late Model Cardwell Double Drum Spudders, Ser. #RL-686 and RL-701, complete with large inventory of tools and equipment (extra good). General Tool & Supply Co., Box 4387, Oklahoma City, Okla.

CAMAIR TWIN NAVION: Best twin airplane for short, rough fields. Take-off 600 feet, full load. 240 hp. engines. 185 m.p.h. cruise. Four place. 280 lb. cargo. 530 hours airframe, 310 hours left engine, 15 hours right engine. Fully equipped for instrument flying. All dual equipment. New cost: $44,150. For sale or trade. Make offer. Box K-247, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE EQUIPMENT

LIQUIDATION— TIDEWATER OIL COMPANY

DRUMRIGHT, OKLA., MODERN 15,000 BBL./DAY REFINERY

HOUDRIFLOW CATALYTIC CRACKING UNIT, 8000 BBL./DAY (NEW 1952)

VACUUM CRUDE DISTILLATION UNIT, 15,000 BBL./DAY (NEW 1953)

HOT OIL PUMP—PACIFIC 8 STAGE CENTRIFUGAL SS LINED TYPE ITB 2½" 334 GPM @ 1000 PSI 750° F. 312 BHP

- CONDENSERS—HEAT EXCHANGERS
- NEW FURNACE & CONDENSER TUBES
- PRESSURE VESSELS
- PUMPS
- REBOILERS
- TANKS
- TOWERS
- CHEMICALS, PAINTS, DYES, WAREHOUSE SUPPLIES

Write For Complete Brochure

Heat & Power Co., Inc.

NEW YORK OFFICE—60 East 42 St., New York 17, N. Y.

TULSA OFFICE—310 Thompson Bldg., Tulsa 3, Okla., Diamond 3-4890

DRUMRIGHT OFFICE—P. O. Box 587, Drumright, Okla., Phone 569

FOR SALE EQUIPMENT

PILING FOR SALE in Texas and La. 600 tons ZP-32 and ZP-27—Sheel Sheet Piling in 35 ft. and 48 ft. lengths. The Darien Corporation, 49 E. 41st St., New York 17, New York.

USED LATE MODEL 71, 72 and 83 Speedstars, 24L Bucyrus and 1500 Failing rotary, all complete with tools. Star Drilling Supply company, Manufacturers of Rotary and Cable Tools.—Chanute, Kansas.

1 36L BUCYRUS Spudder complete with 5 and 7 inch tailing in tools. Dog house, butane tank, junk rack and light plant. Rod and tubing tools and hand tools. Phone Office 144, Res. 614, Cleveland, Oklahoma.

EQUIPMENT WANTED

GOOD USED binocular microscope. State make, age, magnification and condition. Box K-251, The Oil and Gas Journal, Tulsa, Oklahoma.

HELP WANTED

SEISMOGRAPH PARTY CHIEF for Rocky Mountains, must be above average in interpretation and managing field party. Good salary, expenses, auto and profit sharing. Permanent employment with an aggressive, growing firm. Our employees are aware of this ad. Box K-246, The Oil and Gas Journal, Tulsa, Oklahoma.

FOR SALE

A clean D7 Caterpillar tractor, series 4T with an inside hydraulic 8' blade and a D7N Hyster worm driven winch. Serial #19131.

For further information concerning this equipment call

HENSON DRILLING COMPANY

OR 2-4112, or write to Box 2192, ABILENE, TEXAS

NEW ROTARY RIGS FOR SALE

We are discontinuing our contracting business and have two rigs, now on contracts. One rig for 7,500 foot wells and one for 3,500 to 5,000 foot wells.

If interested in purchase, can furnish inventory and can inspect rigs while operating.

Call or Write

H & H DRILLING COMPANY

Phone MUrray 2-2032,
P. O. Box 54, Wichita 1, Kansas

Refinery Process Engineer

Established Independent Oil Company has immediate opening for graduate Process Engineer with five to ten years refinery operating and process engineering background. Excellent opportunity. Send personal history, education, employment record and salary expected. Write:

P. A. Kahle

The Frontier Refining Company

P. O. BOX 418
CHEYENNE, WYOMING

LIQUIDATION 11,000 BBL. REFINERY

D-X SUNRAY OIL CO., ALLEN, OKLA.

We are now liquidating this modern refinery and can offer equipment at a fraction of its cost.

INCLUDED ARE: 6 Heaters with Chrome Tubes, Welded Towers from 2' to 8' with Operating Pressures up to 475 psi., Reboilers, Accumulators, Heat Exchangers, Hot Oil Pumps, Centrifugal and Steam Pumps, Boilers, Gas and Diesel Generator Sets, New Chrome Heater Tubes, Pipe, Valves, etc.

Your Inspection Is Invited. Write for Catalogue.

HEAT & POWER CO. Inc., 60 E. 42 St., New York 17, N. Y.
310 Thompson Bldg., Tulsa 3, Okla.

CHEMICAL ENGINEER for FAR EAST

To supervise startup and initial operations of new ammonia plants in Formosa and Korea.

Graduate Chemical Engineer with extensive ammonia plant operating experience including trouble shooting during startup and initial operations.

This is a challenging position with excellent salary and opportunity for growth with leading contractor specializing in low temperature plant design, erection, and operation.

Please mail in confidence complete chronological resume, including education and employment, salary history and salary requirement to Personnel Department

HYDROCARBON RESEARCH, INC.

115 Broadway New York 6, N. Y.

HELP WANTED

REFINERY ENGINEER for independent company located in Kansas. Project estimating, design and drafting experience. Give detailed resume of education, experience and salary expected. Box K-226, The Oil and Gas Journal, Tulsa, Oklahoma.

PROCESS ENGINEER. Supervisory opening in operations as Unit Foreman to right man with 4 or 5 years refinery experience. Furnish record of education and experience. Box K-213, The Oil and Gas Journal, Tulsa, Oklahoma.

Challenging Position

We have challenging, responsible supervisory position open in our asphalt research program. Applicant must have considerable experience and background in the formulation and evaluation of asphalt specialty products, supervisory ability, and suitable academic background. Will also assist in technical sales development program. Salary open.

Write Giving Qualifications To:

Emmett R. Coley, Supervisor
Technical Recruitment

Lion Oil Company Division

Monsanto Chemical Company
El Dorado, Arkansas

HELP WANTED

PETROLEUM ENGINEER to be based in Bartlesville to manage water flooding operations of aggressive company in northeast Oklahoma. Prefer man with approximately five years' experience, with one or two years specialization in secondary recovery. Salary open. Address Slick Secondary Recovery Corporation, Milam Building, San Antonio, Texas.

CORROSION ENGINEERS: Outstanding opportunity for college graduates with recent field experience, as sales representatives for new Chemicals Division of progresive company. Tuf-Plate Corrosion Inhibitors, related chemicals and processes. Age 27-33. Write Cherokee Laboratories, Inc., Box K-227, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEERS
GEOPHYSICISTS
(South America)

Immediate openings with major oil company for graduate engineers with experience in drilling, production, reservoir and equipment; also geophysicists experienced in interpretation and supervision. Working knowledge of Spanish desirable but not essential.

Liberal Employe Benefit Plans. Salary commensurate with experience.

Forward personal data and college transcript to: Box K-249, The Oil and Gas Journal, Tulsa, Oklahoma.

Magnolia Petroleum Company

An opening exists for an experienced equipment engineer to be assigned to our Division Petroleum Engineering Staff located in Houston, Texas. Applicant must be highly competent in the application of all phases of production equipment.

Several openings are available for experienced chemical engineers. Experience should be in general field of Chemical Engineering relating to crude oil production operations including corrosion control and water treatment.

Salary commensurate with ability and experience. Age limit 40.

Apply to:

D. V. Carter, Chief Petroleum Engineer, Petroleum Engineering Department

MAGNOLIA PETROLEUM COMPANY
P. O. Box 900, Dallas 21, Texas

PETROLEUM OR CHEMICAL ENGINEER
MAJOR OIL COMPANY

has opening for graduate Petroleum or Chemical Engineer involving above ground petroleum losses. Applicants should preferably be between 28 and 35 and should have a minimum of 5 years field experience in the production fields, natural gasoline plants or gathering line systems. The position is permanent, located in New York City, with some travel involved.

Submit full particulars in resume form together with salary requirements. All replies will be held in strict confidence.

Box K-225, The Oil and Gas Journal,
Tulsa, Oklahoma.

GAS PLANT SUPERINTENDENT

Graduate Engineer required as Gas-Gasoline Plant Superintendent in Alberta. Previous operating experience as a prerequisite. Full employee benefits.

Apply in writing to

The British American Oil Company Limited,

Attention: A. A. WILLIAMS,

P. O. Box 130,

CALGARY, ALBERTA

HELP WANTED

FOREIGN EMPLOYMENT. List oil companies, drilling contractors, seismograph contractors, showing where apply foreign jobs, $5.00 cash. OIML Co., Box 2603, Tulsa, Okla.

BOOKKEEPER. Age 50 or over. Full or part time. Must be able to take full charge of dept. Must be of good character; sober; and have a lot of oil and gas experience. Okla. City independent oil company. Give references and qualifications first letter. Box 1824, Okla. City.

Petroleum Engineers

Major independent with high growth potential is seeking petroleum engineers with up to five years experience for employment in its production department.

The starting salary for this callenging opportunity will be commensurate with your experience.

Please furnish complete details in regard to qualifications and experience, including salary required. If applicants are now employed, replies will be kept confidential.

Box K-208,
The Oil and Gas Journal,
Tulsa, Oklahoma.

SOUTH AMERICA

• Career employment with Major American Oil Companies • Salaries Open • Cost of Living Allowance • Monthly Bonus.

NO U. S. INCOME TAX
OUR FEE AND TRANSPORTATION PAID
Maximum Age to 40

- ENGINEERS, ALL TYPES—Degree required. Exp. or inexperienced.
- GEOLOGIST, Deg.—Age to 32. Single.
- TOOLPUSHERS, 3 to 5 yrs. experience.
- MECHANIC GAS, 5 yrs. experience.
- MECHANIC DIESEL, 4 yrs. experience.
- FOREMAN CONNECTION, 3 yrs. experience.
- FOREMAN PRODUCTION, 5 yrs. experience.
- MUD TECHNICIAN, 1 yr. experience. Age to 32.
- STENOGRAPHER, Male, 1 yr. exp. Age to 32. Must be single.

All information confidential.
Send complete resume to:
OVERSEAS EMPLOYMENT SECTION

CHAS. J. LOVELESS
PERSONNEL SERVICE
616 S. Main • Tulsa, Okla. • GI 7-3193

GAS ENGINEER

For Caracas, Venezuela

CHEMICAL ENGINEERING DEGREE.
MINIMUM 5 YEARS EXPERIENCE

including compressor plant operations, design and operating gasoline plants and gas pipeline work. Capable setting up department when required and working with government representatives.

GOOD SALARY, ALLOWANCES, OPPORTUNITY OBTAIN ADDITIONAL EXPERIENCE AND ADVANCEMENT.

Send complete details to:

C. L. LAUE

SOCONY MOBIL OIL CO., INC.

NEW YORK 4, NEW YORK

HELP WANTED

SEISMIC COMPUTERS with Degree in Geology or Geological Engineering needed by large independent oil company for work in Oklahoma. This is an excellent career opportunity for a recent graduate or for a person having up to three years experience. Applicants should submit a college transcript, photograph, and a summary of work background. Box K-215, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEERS. Independent oil company has openings in West Texas, Northern and Central Louisiana for graduate petroleum engineers under 35 years of age, with knowledge of field production problems, work-overs, completions, and water flood operations. Replies confidential. Send resume with small photo and transcript of college credits to P. O. Box 2162, Dallas 21, Texas.

OPERATING ENGINEER

For Writing Operating Manuals

To compose operating instructions for petroleum refinery, chemical and petrochemical plants. Will also assist in activities of New York Operating Department.

Graduate Chemical or Mechanical Engineer with minimum 5 years experience in performing similar work with petroleum refiner or contractor. This is a challenging position with an excellent opportunity for growth.

Please airmail in confidence complete chronological resume, including education and employment, salary history and salary requirements, to Personnel Department

HYDROCARBON RESEARCH, INC.

115 Broadway New York 6, N. Y.

. . . ELECTRICAL . . .

ENGINEERS

Subsidiary operating in Venezuela has career openings for 2 graduate electrical engineers with experience in design, construction & maintenance of power generating & distribution systems.

QUALIFICATIONS:—

B.S.E.E.—Minimum 3 years

Diversified experience

Salary Commensurate with Experience

. . . GULF OIL . . .

Corporation

P. O. Box #35

Bowling Green Station

New York 4, New York

HELP WANTED

CONTRACT COMPANY will pay top salary and over for qualified seismic computers, observers, and surveyors. Opportunities excellent. Give details of education, experience, and salary desired. Replies confidential. Box K-257, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

GEOLOGIST: nine years Texas and Mid-Continent. Major, independent as District and Chief Geologist, and consulting experience. Can handle exploration, development, evaluation, completion. Masters degree. Desires responsible position with independent company. Box K-237, The Oil and Gas Journal, Tulsa, Oklahoma.

REFINERY MANAGER desires position in south as refinery manager or terminal manager. 43 years of age, 25 years experience. Reply, if interested to: Box K-229, The Oil and Gas Journal, Tulsa, Oklahoma.

FINANCIAL EXECUTIVE — M.B.A. finance. Good Wall Street connections. Desires assoc. with Independent needing expert financial counsel. Formerly controller Independent. Box K-232, The Oil and Gas Journal, Tulsa, Oklahoma.

THERMAL CRACKING, crude unit and absorption plant operator with ten years experience at superintendents level desires connection as refinery or terminal superintendent. Box K-234, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST—7 years experience—thoroughly trained all phases. Can handle exploration and development program. Working knowledge of Land, Production, Tax and Finance. Abundant professional and business contacts. Desire salary-interest or retainer arrangement. Presently employed. Box K-223, The Oil and Gas Journal, Tulsa, Oklahoma.

CONSULTING GEOLOGIST: Albuquerque, New Mexico. B. S. Degree, 6 years' experience all phases of exploration, development, land, drilling deals in West Texas, New Mexico, Four Corners Area, Julesburg Basin, and Wyoming. Desires retainer-interest position with active operator. Good references. Jack Q. Frizzell, 7114 Central, S. E., Albuquerque, New Mexico.

GEOPHYSICIST: Age 30, veteran, B.S. degree in geology. Five years experience in Rocky Mountain area and Canada. Some Gulf Coast experience. Desires position with small company or independent. Box K-222, The Oil and Gas Journal, Tulsa, Oklahoma.

MANAGER - PRODUCTION: Here is an exceptional opportunity to obtain the results of long experience with heavy responsibility. An Engineer with ability to manage all phases of a producing company desires to change. A request will bring full particulars for your consideration. Box K-254, The Oil and Gas Journal, Tulsa, Oklahoma.

SIXTEEN YEARS EXPERIENCE pipeline operation, pipeline maintenance. Includes six years in states, ten years with major oil company in Venezuela. Speak Spanish. Box K-253, The Oil and Gas Journal, Tulsa, Oklahoma.

DRILLING SUPERINTENDENT. Age 34. Graduate Engineer. Married 10 years experience in Drilling and Production work wants job with drilling contractor or small production company. Box K-250, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM GEOLOGIST - SUPERVISORY: Seventeen years combined experience; 12 years East Texas, Arkansas, Louisiana, Mississippi, and Southeastern United States. Extensive background in exploration, development, and evaluation at management level. Widely known, good standing and reputation, excellent references. Wish to relocate. Available immediately. Will consider Canadian or domestic employment. Box K-252, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEER-SUPERVISOR. Age. 29. Five years intensive major company experience in production, drilling, workover and operations, Permian and San Juan Basins as Petroleum Engineer and Field Supervisor. B.S. Mechanical Engineering. Desire responsible position with smaller company with chance for advancement. Prefer Northern New Mexico or Colorado. Box K-255, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

REFINERY SUPERINTENDENT desires connection with refining or petrochemical company. Twenty years experience with proven administrative ability in all phases modern refinery operations. Excellent references. Box K-256, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM REFINERY ENGINEER B.S., married, 32, seven years experience. Desires relocation to West Coast. Broad background including equipment design, and performance economics. FCCU and cat reformer operation. Box K-248, The Oil and Gas Journal, Tulsa, Oklahoma.

ROYALTIES

HIGHEST PRICE PAID for oil and gas income royalties, overrides, oil properties. A. S. Berry, 520 Wright Bldg., Tulsa, Oklahoma.

LEASE AND DRILLING BLOCKS

640 ACRE producing lease, Strahn Pool, Nemaha County, Kansas. Will faromut lease and equipment. R. D. Swan, 818 Kennedy Building, Tulsa 3, Oklahoma.

OIL AND GAS MINERAL LEASES available in Dell City area of Hudspeth County, Texas. U. S. Geological Survey Map shows anticlinal axis nearby favorable for oil-gas structure. Am fee landowner of over 2000 acres. Write quickly to: Jefferson G. Smith, 215 Littlefield Building, Austin 15, Texas.

800 ACRE OIL LEASE

Near Chanute, Kansas, shallow, 2 wells on pump, and water flood equipment. Very good possibilities. Sell at sacrifice. $11,500 (Owner). Box K-230, The Oil and Gas Journal, Tulsa, Oklahoma.

EXPERIENCED OPERATOR will sell interest to help drill direct offset to shallow well that made 50 bbls., 40 gravity oil on 240 acre lease or will take small override. Write Paul Denton, Box 362, Coweta, Okla.

UTAH OIL LEASES

on lands owned by U. S. gov't. 640 acre 5 year leases; renewable 5 more. Very small rent. You do no drilling; pay no taxes; may assign lease to oil companies. Read customers' letters who did, for good cash profits and retained royalty in lease. We have land selected and file your lease application in gov't. office. Great lease boom in Utah. Fine speculation. Information free. John L. Donahue, Empire Build., Denver 2, Colo.

OIL LEASES IN BOOMING

4-Corners Area. November Indian Lease sale brought 30 Million Dollars. Some leases sold for $3,200 per acre. Wells estimated up to 1500 barrels of oil per day. Oil Leases from $2.25 an acre. Fortunes being made. Write for free information now. ATLAS OIL SURVEY, Dept. OJ-7, Colorado Bldg., Denver 2, Colo.

PARADOX BASIN

1,611 acres in Utah on U.S.D.S. services structure. $10 per acre for quick sale. For free geological map, call collect AC 2-1363 or write

C. E. STOUT,

COLORADO BLDG.,

DENVER, COLO.

REAL ESTATE

MALIBU, CALIFORNIA

160 acres mountains and canyon. 500 Oak Trees. For Ranch Estate or future sub-division. Ocean View. Highway 1 mile. Proposed highway through property. Full oil rights. Now leased by Gulf. $55,000. Owner Tom Runyon, 1600 Ocean Front, Santa Monica, California. EXbrook 3-1194.

BUSINESS SERVICE

NUCLEAR INSTRUMENTATION and consultation for oil producing operations. Nucor Research, Inc., 2421 Wolcott, Ferndale, Michigan.

Delaware Corporations formed and serviced. American Guaranty & Trust Company, P. O. Box 487, Wilmington, Delaware.

WANTED

WANTED—Oilfield sales and service organization to act as manufacturers representative for production equipment. Distributorships now available for California and Oklahoma. Box K-243, The Oil and Gas Journal, Tulsa, Oklahoma.

Successful Wildcats

EAST TEXAS

Cherokee County: Columbian Fuel Corp. 1 B. F. Alexander, Milton Burns Sur., A-123, 5 miles S. Rusk, discovery of South Rusk field. IP 123 BOPD, ¼-in., TP 160 psi., 28.4°-gravity, GOR 371, Woodbine 5,151-55 ft., TD 5,223 ft., elev. 515 ft.

Robertson County: B. B. Orr 1 George Abraham, Dennis Hagerty Sur., 5 miles SE Bremond. IP, calculated open flow, 5,300 M.c.f. gas, with GOR 603,000:1, 50°-gravity condensate. Shut-in pressure 1,952 psi., Edwards limestone perfs. 4,726-31 ft. TD 4,800 ft., elev. 467 ft.

NORTH TEXAS

Archer County: Bridwell Oil Co. 1-A Ikard, 2-5-Clark & Plumb, 9½ miles SE Archer City, offsets 4,115-ft. production. IP 41 BOPD, 8/64-in., 41°-gravity, GOR 472, TP 200 psi., perfs. 5,250-60 ft. TD 5,576 ft.

Burt Drilling Co. 3 Ikard, Joseph Levins Sur., A-260, 6 miles SE Archer City. IP 250 BOPD, 14/64-in., 42°-gravity, GOR 412, CP 180 psi., Caddo 4,740-47½ ft.; dual discovery, IP 184 bbl. oil in 4 hours, 12/64-in., 44°-gravity, GOR 280, TP 720 psi., Mississippian 5,313-23 ft. TD 5,400 ft.

LaGorce Oil Co. 1 Joyce Prideaux Hornady, Sec. 1836, TE&L Sur., A-520, 7½ miles E Anarene. IP 210 BOPD, 14/64-in., 42°-gravity, GOR 550, Mississippian 5,274-84 ft. TD 5,292 ft.

SOUTHWEST TEXAS

Hidalgo County: Hargrave Oil Corp. 1 Jackson, Valley Farms Subd., Block 84. IP 8,500 M.c.f. daily, open-flow potential, 7.25 BC per M.M.c.f., 50.3°, perforations 8,758-8,809½ ft. (Frio). TD 10,123 ft. (New pay in North Monte Christo field.)

TEXAS GULF COAST

Bee County: Skelly Oil Co. 1 Zook, John Van Bibber, Sur., A-582. IP 19,500 M.c.f. daily, open-flow potential, GLR 48,150 cu. ft. per bbl., 52.5°, perforations 8,576-90 ft. (Wilcox-Luling). TD 9,100 ft. (New field—1 mile north of Normanna.)

Hardin County: Sinclair Oil & Gas Co. et al 1 J. Ellery fee, Joseph Ellery League, A-17 (¾ mile southeast of Silsbee field). IP 64 BOPD, ⅛-in., 45.5°, GOR 3,372 cu. ft. per bbl., perforations 10,986-11,016 ft. and 11,056-64 ft. TD 11,500 ft. (New oil reservoir.)

WEST CENTRAL TEXAS

Throckmorton County: Warren Petroleum Corp. 1 Brockman, TE&L Sur., A-270, 5½ miles SE Woodson. IP 160 BOPD, 14/64-in., 42°-gravity, GOR 273, TP 210 psi., Caddo 4,032-38 ft. TD 4,633 ft., elev. 1,186 ft.

SOUTH LOUISIANA

Calcasieu Parish: Sun Oil Co. 3 Miller-Fruge, 31-11s-6w. Shut-in gas well, no gage, perforations 9,960-68 ft. TD 13,265 ft. (New pay in North Chalkley extension area.)

Cameron Parish: Humble Oil & Refining Co. 1 State Lease 2497, 30-15s-10w. IP 797 M.c.f. daily, ⅛-in., dry gas, TP 2,500 psi., perforated 6,883-93 ft. TD 10,400 ft. (New pay and second well in Calcasieu Pass field.)

COLORADO

Washington County: Wytex Oil Co.-J. G. Ladmer 1 Robbins, C NE SE 34-3n-52w. IPP 28½ BOPD, "D" sand discovery, new field. TD 4,860 ft. Skull Creek.

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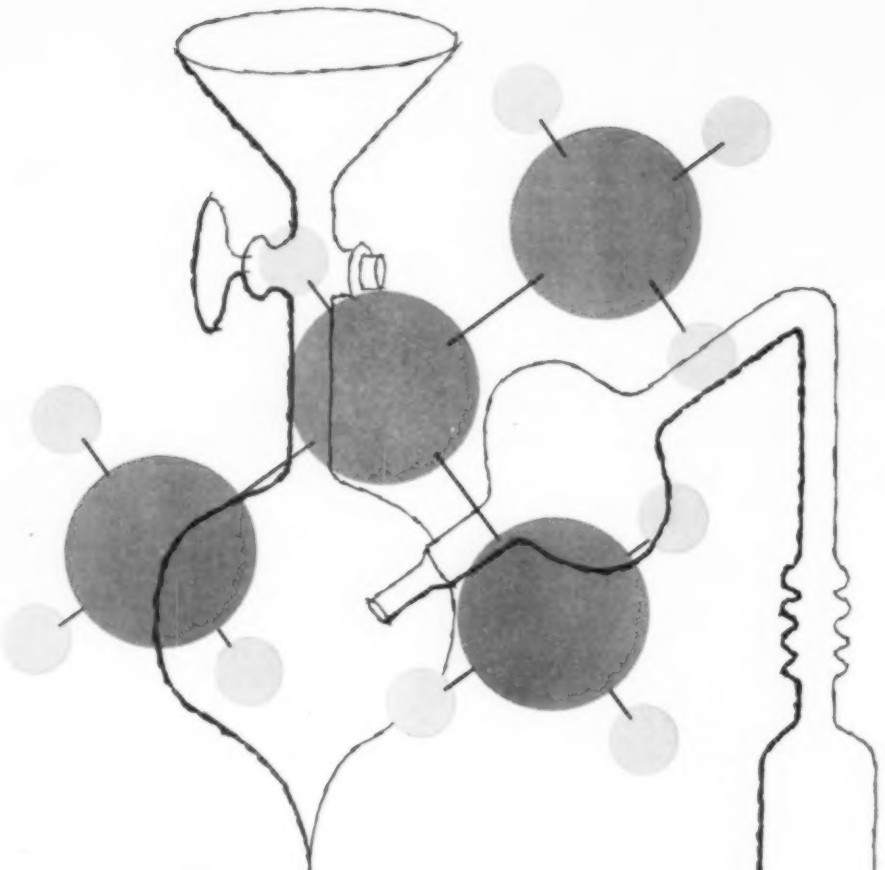

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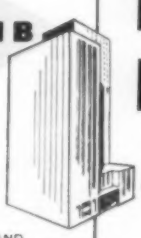

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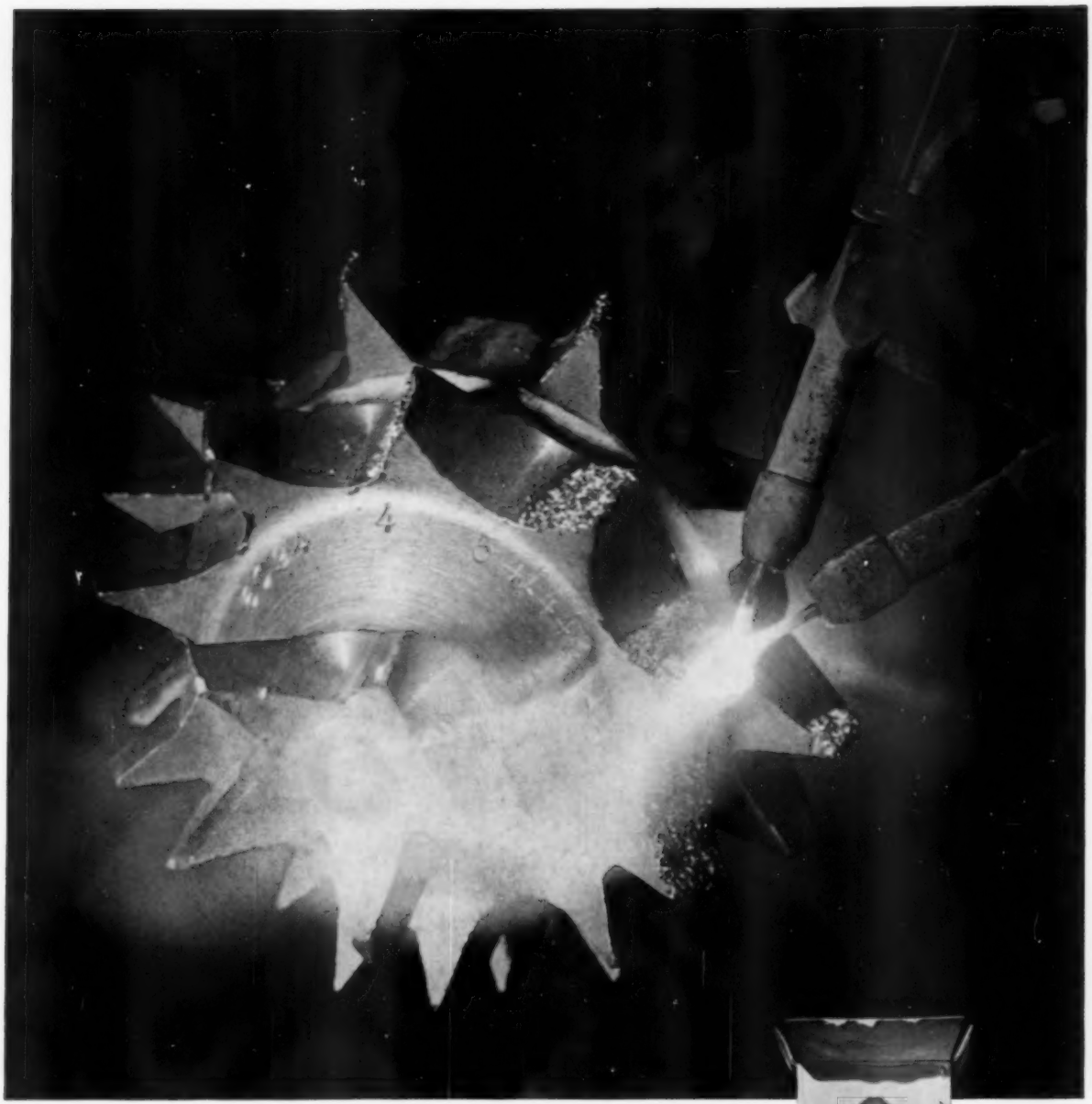

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